

The WANDERING MINSTREL of TODAY

HOW far have we progressed from the days when the minstrels, singing their self-composed ballads to the accompaniment of harp or lute, or telling their stories illustrated with crude mimicry, wandered from castle to castle in old England furnishing to the nobility practically the only entertainment available.

To-day every American, no matter how far removed from the centers of activity has within his reach up-to-the-minute news and amusements that would have delighted the hearts of the nobility of old. The air is filled with merriment waiting to be captured and brought to your very fire-side.

Radio is the magic wand that attracts to you the desired entertainment. Crosley Radio Receivers are the instruments by which this entertainment may be clearly and distinctly converted into a true reproduction of the original voice thousands of miles away.

You can own and enjoy a Crosley Radio Receiver. Unique features and quantity production have enabled us to offer the greatest value in radio ever produced. Actual tests by hundreds of satisfied users in all parts of America have proven that in performance, Crosley Instruments are unexcelled. And the prices are remarkably low.

Crosley Manufacturing Company owns and operates broadcasting station WLW.



Let a Crosley Radio Receiver Bring Perpetual Entertainment To Your Home.

For Sale By Good Dealers Everywhere

Write for Complete Catalog fully describing the Crosley line of Radio parts and Receivers

CROSLEY MANUFACTURING COMPANY

Powell Crosley, Jr., President

217 Alfred Street

Cincinnati, Ohio

CROSLEY

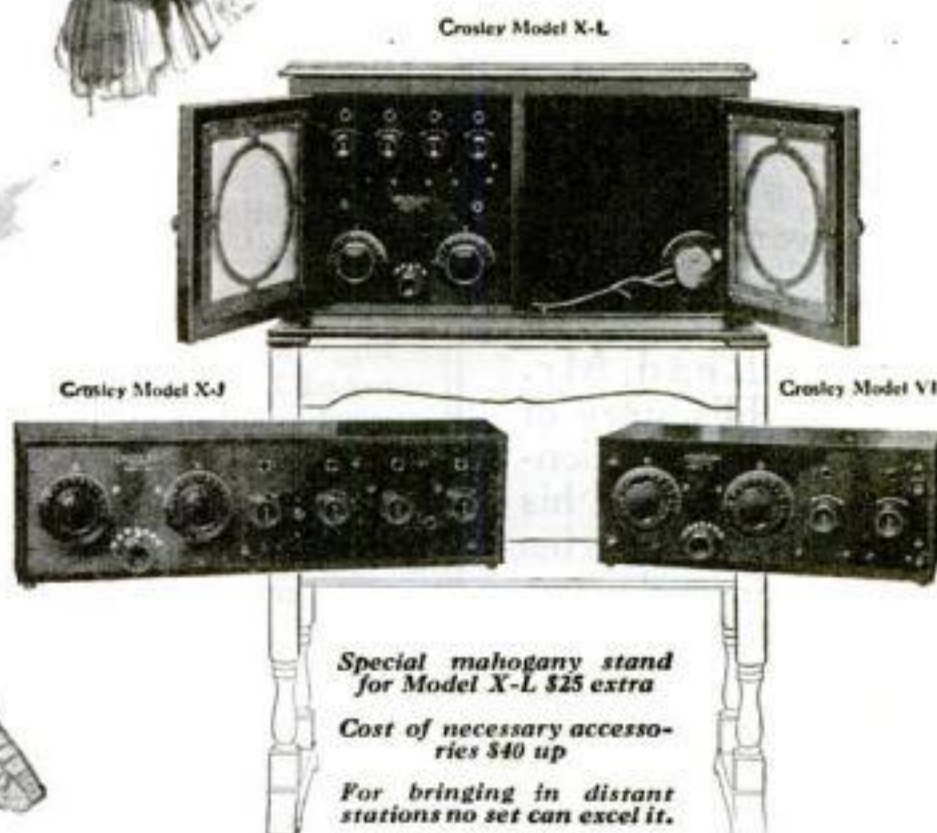
MODEL VI \$30
Two Tube Set

MODEL X-J 65
Four Tube Set

MODEL X-L 140
Four Tube Set
With Built-in Loud Speaker



CROSLEY
Better - Cost Less
Radio Products



Special mahogany stand for Model X-L \$25 extra

Cost of necessary accessories \$40 up

For bringing in distant stations no set can excel it.

MODEL VI—\$30. A wonderfully efficient two tube set, one stage of Tuned Radio Frequency Amplification and Detector.

MODEL X-J—\$65. A four tube radio frequency set combining one stage of Tuned Radio Frequency Amplification, a Detector and two stages of Audio Frequency Amplification. A jack to plug in on three tubes for head phones, the four tubes coupled up for loud speaker.

MODEL X-L—\$140. A duplicate of Model X-J except the arrangement and mounting into a beautiful cabinet with the addition of a built-in loud speaker and space in the cabinet provided for housing the necessary batteries. Makes a beautiful piece of furniture.

-----MAIL THIS COUPON TODAY-----

CROSLEY MANUFACTURING CO.,

217 Alfred Street, Cincinnati, Ohio

Gentlemen:

Please mail me free of charge complete catalog of Crosley instruments and parts together with booklet entitled "The Simplicity of Radio."

Name.....

Address.....

POPULAR SCIENCE MONTHLY

Most Wonderfully Illustrated Magazine in the World

FEBRUARY, 1924; Vol. 104, No. 2
25 cents a Copy; \$2.50 a Year



Published in New York City at
225 West Thirty-ninth Street

FROM Seattle comes an interesting query: "For some time I have been working on an idea that I believe will lead to an important scientific discovery. But I am discouraged because my friends give me the laugh. Is it worth while to keep on trying?"

The writer says his investigations show the world has a real use for his product and that it can be manufactured at a reasonable cost. And, he adds, he has the mental equipment to see his idea through.

* *

IS IT worth while to keep on trying? Turn to page 31 of this issue. Read Mr. Francis Jehl's story of Edison. People, scientists of repute and his friends, jeered at his idea of an incandescent lamp. And even as they jeered he was lighting his little workshop with his lamps. Today the world that jeered cheers at the mention of his name.

* *

REMEMBER Robert Fulton. He and his steamboat were the butt of countless jokes. A widely known British marine engineer "proved" by mathematics that the idea of running a boat by steam, independent of wind, was "preposterous." But before the ink was dry on his published article, a steamboat had landed in England. The laughter of skeptics infused zest into Fulton's task, and it was he who had the last laugh.

SCIENTIFIC achievement and inventive accomplishment frequently mean the ability to face derision. It is human nature to oppose that which we do not understand. Worry over the sneers of the heedless only wastes the spirit's substance. Such worry only increases your problems and leaves you weaker to handle them. Refuse to heed such taunts and they will cease to annoy you.

* *

A POOR inventor once waited for four hours outside the office of Commodore Vanderbilt, the railroad magnate. He had an invention he wanted to sell for \$10,000. Finally Vanderbilt said: "Tell that man I have no time to waste on fools." The inventor was George Westinghouse. His invention was the airbrake. Such a rebuff might have chilled the heart of a weakling. But Westinghouse believed in his idea. And, it is said, Vanderbilt's sneer only forced him into grips with his problem, the conquest of which brought him millions.

* *

IF YOU are sure of your idea, have the curiosity to find out about things and the energy to overcome obstacles. It is always

worth while to keep on trying. Concentrate all of yourself on a worthy purpose. Don't be too modest. Close your ears to jeers and say to yourself—IT CAN BE DONE!

In Next Month's Issue

My Fellow Scientist—The Rat—The fascinating story of how a scientific investigator, by experimenting with rats, discovered valuable new facts about diet and its relation to health and longer life.

Private Conversations by Radio—A glimpse at approaching marvels of radio communication, as forecast by Jack Binns, America's foremost writer on radio subjects.

Mechanics in the Jungles—The startling adventures of Capt. Frank Hurley, noted British explorer, whose knowledge of mechanics proved an invaluable aid in the wilds of New Guinea.

Your Headlights and Your Safety—Simple tricks of adjustment that will insure your car against disaster in night driving.

Success in the Backyard Garden—An expert's timely suggestions for planning, planting, and growing the summer crop of vegetables.

And 200 other fascinating articles and pictures

POPULAR SCIENCE MONTHLY

Issued monthly. Single copy, 25 cents. Yearly subscription to United States, its possessions, and Canada, \$2.50; foreign countries, \$3. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1924, by the Modern Publishing Co. The contents of this magazine must not be reprinted without permission. H. J. Fisher, President; R. C. Willson, Vice-President O. B. Capen, Secretary and Treasurer



NOW FREE!

The Book That Has Shown Thousands the Way to Amazing Salary Increases

TAKE this situation. A man who had worked all his life in a routine job at low pay suddenly surprises his friends by moving into a better neighborhood, taking a big house, buying a car and blossoming out as a well-to-do and influential citizen in his new community. How did he do it? What is the secret that he used? Simple enough. He knew that the biggest money in business is in Selling, and though he felt that he couldn't sell a thing, he learned the secrets that make Master Salesmen and then began to make big money.

If only one man had found inspiration enough in this remarkable book to make a brilliant success in the Selling field—in a job paying him many times his former salary—then you might call it luck. But thousands have done it.

Your One Chance to Make the Biggest Money of Your Life

Not one of the men whose names appear below had ever sold a thing before—not a dime's worth. If you had told one of them that he could sell he would have laughed at you. Yet every one of these men, through reading this book, discovered the fallacy of this vicious old idea that Salesmen are "born." They learned that *Master Salesmen are made!* And in this book they found a comparatively easy way to go from low pay to better earnings.

Simple as A B C

Sounds remarkable, doesn't it? Yet there is nothing remarkable about it. There are certain ways to approach different types of

prospects to get their undivided attention—certain ways to stimulate keen interest—certain ways to overcome objections, batter down prejudices, outwit competition and make the prospect act. If you will learn these principles there is awaiting you a brilliant success and more money than you ever thought of earning. This book, "Modern Salesmanship," tells exactly how the National Salesmen's Training Association will make you a Master Salesman. As soon as you are qualified and ready the Employment Service of the National Salesmen's Training Association will help you to select and secure a selling position as city or traveling salesman.

Now Free to Every Man Who Will Act at Once

We are not making any extravagant claims about what we will do for you. We don't have to. The records of the real successes for which we are responsible are such overwhelming evidence of the fact that any man of average intelligence can become a Master Salesman, that we are willing to leave the decision entirely up to you. All of this proof and many important features about Salesmanship are contained in "Modern Salesmanship." It is yours—FREE. Send the coupon for it today.

It will show you how you can quickly become a Master Salesman—a big money maker. It will tell you about the National Salesmen's Training Association system of Salesmanship training that has meant prosperity to so many thousands of men—about the National Demonstration Method that gives you actual experience while studying—and all about the fine opportunities that await you in the selling field. Failure to act may mean that you lose the one big chance of your life to leave forever behind you the low pay of a routine

job. It may mean the difference between this and a real success at a big salary. Is it worth 2c to find out? Then mail this coupon NOW.

job. It may mean the difference between this and a real success at a big salary. Is it worth 2c to find out? Then mail this coupon NOW.

National Salesmen's Training Association
Dept. 15-B
Chicago, Illinois


National Salesmen's Training Association
Dept. 15-B, Chicago, Ill.

I simply want to see the facts. Send me FREE your Book, "Modern Salesmanship," and Proof that I can become a Master Salesman.

Name.....
Address.....
City..... State.....
Age..... Occupation.....

EMPLOYERS are invited to write to the Employment Dept. of the N. S. T. A. We can put you in touch with just the men you need. No charge for this service to you or our members. Employers are also cordially invited to request details about the N. S. T. A. Group Plan of instruction for entire sales forces. Synopsis and charts sent without obligation.

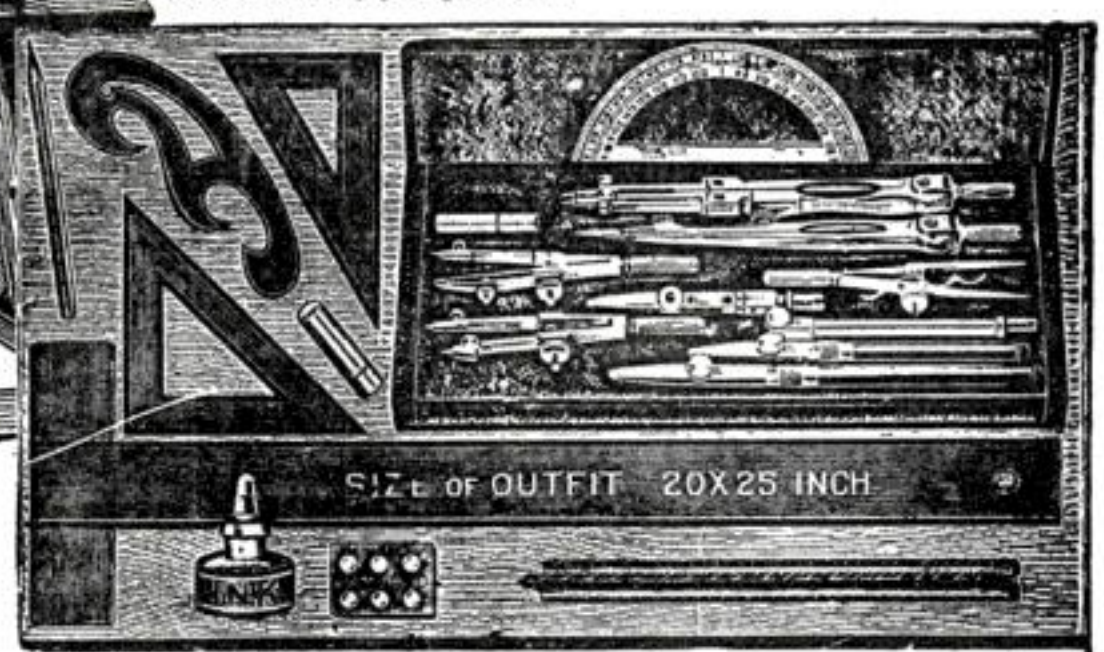
Drawing Table Free!



Yes, this is exactly what I am doing, I am giving this drafting table free to you when you enroll as my student. I do this because I want you to have the right kind of Draftsman's Working Outfit—because I want to help ambitious men and boys get ahead. This is the kind you will use when you have completed my course and have become a regular draftsman.

Complete Drawing Outfit FREE

Besides the drafting table I also furnish free the set of regular working instruments shown here. You get both table and instruments free if you enroll at once. I will do everything possible to help you get ahead.



Also FREE \$90 Drafting Course

To my students enrolling now I give an opportunity of getting a \$90 drafting course absolutely without cost to them. This means you need not pay me for my personal instructions or for the complete working outfit.

Salaries up to \$250 and \$300 a Month

Positions paying up to \$250 and \$300 a month which ought to be filled by skilled draftsmen are vacant everywhere. There are in every part of the country ambitious men, who with practical training and personal assistance will be qualified to fill the positions. I can now take and train a limited number of students, guarantee to train them by mail UNTIL placed in a permanent position at a salary up to \$250 and \$300 a month.



Here is the Rule you get FREE

To each young man stating his age when sending a sketch as shown in box at right, I am going to mail FREE AND PREPAID the Draftsman's Ivory Pocket Rule shown here.

Mail Coupon

Mail coupon at once for full information how you can get the table and working instruments Free, also how you can get the \$90 drafting course Free. Even if you don't send in a copy of the sketch send for this information.

Chief Draftsman, Engineers' Equipment Co.
1951 Lawrence Ave., Div. 13-62 Chicago, Ill.

Extra!!

Copy this Sketch and Get Ivory Pocket Rule

To each young man sending a sketch I will mail free prepaid the Draftsman's Ivory Pocket Rule shown here. With it I will send you a 6 x 9 book on "Successful Draftsmanship." Just state your age.

There are no conditions requiring you to buy anything. You are under no obligations in sending in your sketch.



Chief Draftsman, Engineers' Equipment Co.
1951 Lawrence Ave., Div. 13-62 Chicago, Ill.

Without any obligation to me please mail your book "Successful Draftsmanship" and full particulars of your liberal "Personal Direction" offer to a few students. Also full information as to how I can get a \$90 Drafting Course Free.

Name _____

Address _____

Age _____

What's Back of the Man Who Wins?



Did you ever observe what an easy time the man at the top seems to have—compared with the chap underneath?

—Makes more money, too—ever so much more money—yet he practically comes and goes when he pleases, turns all the hard work over to his assistants, and, in fact, "lives just like a lord, while we poor slaves—look at us!"

Sounds familiar, doesn't it—that plaint of the man in the routine job, whose utmost vision is bounded by "fifty a week" and who has deceived himself into thinking that the only way he can ever beat the game is to "work up a pull with the boss"—

Such a man forgets that the one best pull—and the only pull that is worth a continental—is ability to deliver.

And he fails to realize, too, that ability to handle important matters—decide perplexing problems—dictate far-reaching policies—comes only with a sound and thoro understanding of BUSINESS PRINCIPLES AND METHODS—an understanding which invariably must be based upon EXPERIENCE.

There are many ways to GAIN experience—but the shortest and surest route is thru SPECIALIZED TRAINING.

The Confidence That Comes With Knowledge

Because LaSalle Extension University has been privileged to be of aid to thousands of men whose progress had been checked by the fact that they did not KNOW what to do in the more important positions they aspired to—and KNEW that they did not know—it is only right that other men, faced with similar problems, should have an opportunity to find out how these men have overcome that fatal obstacle.

We have therefore assembled from the thousands of letters in our files a composite message to the man who doubts his power for success.

While in practically every case the LaSalle-trained man who writes of his experience has made a gratifying gain in earning power, it will be noted that the thing which has brought him greatest satisfaction is his newly acquired CONFIDENCE—sure stepping-stone, when based on true ability, to the highest and most responsible positions.

The first letter is from a man who had "studied forty-two years" and had finally become a chief chemist, making \$4,000 a

year. When he came to LaSalle he called himself a "business failure." Less than a year later he wrote as follows (the italics in this and subsequent quotations are ours):

"Take away all I have learned for close to 42 years, but leave me my five months' study, and I should not be a loser by any means. Before, I was merely a good chemist, but now I am a man, and am standing squarely on my feet. Accountancy is only a first step, but it is a splendid foundation. It should be supplemented with your course in Business Management. I have taken only three lessons of this last course, but it has opened my eyes. Now I am after a \$12,000 a year job. It is immaterial whether I get it or not. The point is that in my inner self I am convinced that I am worth it, and that I can deliver the goods."

R. H. BOTS, New Jersey.

The following quotations tell their own story:

"It took your course of instruction to give me the courage and self-confidence to tackle the greater task and to enable me to make my dreams come true." (The writer, Mr. Orahod, increased his salary 191 per cent in less than three years.)

C. A. ORAHOD, Ohio.

"Nineteen months ago I was a stenographer with a stenographer's salary and a vague idea that I wanted to know more about my work. Today—thanks to your course in Modern Business Correspondence—I have a department of my own in which I handle the work I used to take in dictation, with a 75 per cent increase in salary. The whole field of business has been opened to

me, and my aims have gone higher and higher. Lately I have had an offer from the sales manager to represent the company on the road. It's the biggest thing that has come my way, and it's the result of LaSalle training."

L. A. M. LEWIS, Ohio.

"Since taking up your training in Law, my salary has increased 123 per cent. The gain came, but it hasn't ended, for where I previously had to sidestep to let a man step ahead of me into a better position, I am now stepping ahead of the other man."

GERBARD A. SCHLEETER, Illinois.

"My course has benefited me many thousand-fold, for it has not only doubled my salary but has given me the confidence and technical knowledge necessary to assume direction in the banking world."

ERIK HANSEN, Wisconsin.

"I have increased my earnings more than three hundred per cent. Strange as it may appear, however, the financial benefits have not made much impression on me. The fascination of the work—the solving of intricate problems—the feeling of dominion, the knowledge that every problem can be solved if we diligently apply ourselves, is worth much more than the financial increase."

C. W. SHELDON, Wyoming.

"When I enrolled, I was a clerk in the cost department of a large foundry. Today, I am office manager, with an increase of about 300 per cent in salary. This course certainly was the starting point; for once a man gets the confidence in his ability that your training gives him, he can take a real job and handle it. Salary increases follow naturally."

W. F. STRUMKE, Wisconsin.

"From a salesman in the ranks, in two short months my sales have shot up nearly 150 per cent, and I have received a promotion from a company I had been with only six months. I am now a district manager, with eleven men working under me. Not only have my immediate sales shown an increase—and right in the middle of the summer months—but I have had a keener grasp of the principles of selling. I know the meaning of 'fundamentals' now; I know that by the application of certain definite truths, certain definite results can be attained. My effort, formerly more or less of an uncertainty, is now a certainty. Getting down to brass tacks, I know what I am doing now."

C. RUTHERFORD, Ontario, Canada.

Make Your Start TODAY!

In preceding paragraphs successful men—men with no better start than you—have told of the working tools that gave them confidence.

These letters could be paralleled by thousands of similar letters—all taken from the files of LaSalle and quoted verbatim—yet there would still be men who would say, "That's all right for them, but it wouldn't help me"—or—"Some day, but not Now."

LaSalle cannot supply initiative—the determination to get on. Men who lack these qualities will not gain by reading further.

Others—men in whom the seeds of success are deeply planted—will profit greatly by the literature LaSalle will gladly send them—and they will send for it today.

The coupon will bring it to you without obligation.

LASALLE EXTENSION UNIVERSITY

The Largest Business Training Institution in the World

LASALLE EXTENSION UNIVERSITY

Dept. 283-R

CHICAGO, ILLINOIS

Please send me catalog and full information regarding the course and service I have marked with an X below. Also a copy of your book, "Ten Years' Promotion in One," all without obligation to me.

☐ Business Management: Training for Official, Managerial, Sales and Executive positions.

☐ Modern Salesmanship: Training for Sales and Advertising Executives, Solicitors, Sales Promotion Managers, Salesmen, Manufacturers' Agents and all those engaged in retail, wholesale or specialty selling.

☐ Higher Accountancy: Training for positions as Auditor, Comptroller, Certified Public Accountant, Cost Accountant, etc.

☐ Law: Training for Bar; LL. B. Degree.

☐ Commercial Law: Reading, Reference and Consultation Service for Business Men.

☐ Traffic Management—Foreign and Domestic: Training for positions as Railroad or Industrial Traffic Manager, etc.

☐ Railway Station Management: Training for Station Accountants, Cashiers and Agents, Division Agents, Traveling Auditors, Transportation Inspectors, Traveling Freight Agents, etc.

☐ Banking and Finance: Training for executive positions in Banks and Financial Institutions.

☐ Modern Foremanship and Production Methods: Training in the direction and handling of Industrial forces—for Executives, Managers, Superintendents, Contractors, Foremen, Sub-foremen, etc.

☐ Industrial Management Efficiency: For Executives, Managers, Office and Shop Employees and those desiring practical training in industrial management principles and practice.

☐ Personnel and Employment Management: Training for Employers, Employment Managers, Executives, Industrial Engineers.

☐ Modern Business Correspondence and Practice: Training for Sales and Collection Correspondents; Sales Promotion Managers; Credit and Office Managers; Correspondence Supervisors, Secretaries, etc.

☐ Expert Bookkeeping: Training for position as Head Bookkeeper.

☐ Business English: Training for Business Correspondents and Copy Writers.

☐ Commercial Spanish: Training for positions as Foreign Correspondent with Spanish-speaking countries.

☐ Effective Speaking: Training in the art of forceful, effective speech for Ministers, Salesmen, Fraternal Leaders, Politicians, Clubmen, etc.

☐ C. P. A. Coaching for Advanced Accountants.

Name _____ Present Position _____ Address _____



Money Making Opportunities for "Popular Science" Readers

AUTOMOBILES AND ACCESSORIES

PATENTS—Write for our Guide Book, List of Patent Buyers and "Records of Invention Blank" before disclosing inventions. Send model or sketch of your invention for our free opinion of its patentable nature. Terms Reasonable. Victor J. Evans & Co., 189 Ninth, Washington, D. C.

AUTOMOBILE Parts—Used parts for most any car at half factory list prices. Allen, Briscoe, Buick, Cadillac, Chalmers, Chevrolet, Dodge, Ford, Grant, Hudson, Humphreys, Oakland, Overland, Oldsmobile, Lero, Studebaker and many others. Send list of parts wanted. Maxwell Bros., 4103 Olive Street, St. Louis, Missouri.

AUTOMOBILE owners, garagemen, mechanics, send for free copy America's popular motor magazine. Contains helpful, money-saving articles on repairing, overhauling, ignition, carburetors, batteries, etc. Automobile Digest, 523 Butler Bldg., Cincinnati.

M. P. LAUGHLIN—Patents-Engineer-Attorney-Specializing Power-Automotive Inventions. 48 East 41st St., New York.

FORD ACCESSORIES

SPEEDSTER fans—see "Red-I-Kut" ad, page 122.

MOTORCYCLES, BICYCLES, SUPPLIES

DON'T buy a bicycle motor attachment until you get our catalogue and prices. Shaw Mfg. Co., Dept. 4, Galesburg, Kansas.

DON'T pay \$50 for bicycles, buy motor cycles \$50 to \$100. Easy terms. Pay as you ride. Non skid Ford tires \$5, tubes \$1.25. Bicycles, motor cycles at factory prices; tubing machines at half price. Records 20c. Send 10c in stamps for catalogues. Deninger Price Cutter, Rochester, N. Y.

MODELS AND MODEL SUPPLIES

We make working models for inventors and experimental work, and carry a complete stock of brass gears and model supplies. Send for catalogue. The Pierce Model Works, Tinley Park, Illinois.

MODEL making and experimental work; modern shop, expert workmen. Manufacturing. Lamson El. & Mfg. Co., 625 W. Jackson, Chicago.

MODELS and Tools. Send sketch for estimate, Arthur Schmidt, 394 Can 1 Street, New York.

MODEL Making Supplies—2" and 4" diameter, special thin brass tubing for Model Boilers, 10c-20c, per inch. Machined ends, per pair, 2", 75c; 4", \$1.50. Miniature machine screws, 3/32" up. Finished Boiler Fittings. Catalogue, 20c. Bathe Mfg. Co., Dept. C, 3214 Woodland Ave., Philadelphia, Pa.

MOTORS, ENGINES, MACHINERY

MOTORS—G. E., 1/2 H.P., \$15.00; 1/4 H.P., \$32.50, 1 H.P., \$62.50. Generators, 8 volt, 10 amp., \$15.00; 32 volt, 500 watt, \$30.00. Other sizes, low prices. Motor Specialties Co., Crafton, Pennsylvania.

USED auto engines excellent for power. We make the governors. P. C. Smith Governor Co., Springfield, N. Y.

RADIO AND SUPPLIES

1500 MILE vacuum tube receiver \$24.50. Radio, 4416 Market, Philadelphia.

RADIO generators 500 V 100 Watt \$28.50 each. Battery chargers \$12.40—High speed motors. Motor-Generator sets, all sizes. Motor Specialties Co., Crafton, Penn.

PURE sheet aluminum and lead, 80c square foot prepaid. Electrical Specialty Company, Valparaiso, Indiana, 9DVK.

YOU don't need tubes to get out of town. If you want new stations on your crystal set, write me today. Mine works 400 to 1,000 miles without tubes or batteries! Thousands have bought my plans and now get results like mine. Changes often cost less than dollar. Send self-addressed envelope for further information. Leon Lambert, 553A So. Volusia St., Wichita, Kansas.

AVIATION

PROPELLERS for aeroplane propulsion, 5-foot diameters, \$12; 6-foot for Fords, \$15; others in proportion. Motorcycle sleigh blueprints, 75c; Ford Size, \$1.00. Pictures free. Crawford Motor and Aeroplane, Long Beach, Calif.

AMERICAN MADE TOYS

MANUFACTURERS on large scale, also homeworkers wanted to manufacture metal toys and novelties. Millions needed of barking dogs, war tail pups, wild animals, automobiles, Indians, cowboys, baseball players, cannons, toy soldiers, crowing roosters, Statues of Liberty, miniature castings of capital, bathing girl souvenirs and others. Unlimited possibilities. Guaranteed casting forms furnished manufacturers at cost price from \$5.00 up, with complete outfit. No experience or tools necessary. Thousands made complete per hour. We buy goods all year and pay high price for finished goods. Cash on delivery. Contract orders placed with manufacturers. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1696 Boston Road, New York.

Another \$25.00 IN PRIZES

To win one of these cash prizes is easy, and every reader is invited to enter this fascinating competition. Just write a letter of not over seventy words answering this question:—

What advertisement of "Money Making Opportunities" in this issue interests you most and why?

Here are the prizes we will pay for the ten best letters answering the above question:—

First Prize.....\$10.00
Second Prize.....5.00
Third Prize.....3.00
And 7 Prizes
of \$1.00 each.....7.00

First read every one of the "Money Making Opportunity" advertisements on pages 6 to 27. Check the ones that interest you. Then read over the ones you have checked and decide on the one that interests you most.

Then write a short letter, *not more than seventy words*, telling us why the advertisement you pick interests you most. Remember that ten prizes will be awarded. You have a good chance of winning one of them. Be sure to mail us your answer before February 1st. The prizes will be awarded, in the order of their merit, for the letters that are most interesting and best expressed.

The names of all the prize winners and the letters that win the first two prizes will be printed in this column in the April issue. Address your prize letter to

Contest Editor

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City

Last Month's Prize Winners

The First Prize of \$10.00 goes to George H. Cole, Federal Tool Company, Wenona, Illinois, for his letter on the advertisement of Charles A. Scott. Here is Mr. Cole's letter:

Dear Sir:—

The ad most interesting to me is Charles A. Scott's "I Sell Patents." First because I answered his ad with satisfactory results. Second, I have noticed his ad in every issue of Popular Science since I have been a subscriber (one year).

Now, if it pays Mr. Scott, why shouldn't it pay me. So I am sending in my ad to be inserted in the next issue of Popular Science.

GEORGE H. COLE.

John S. Cront, San Francisco, Calif., wins the Second Prize for the following letter regarding the advertisement of "Radio World":

Dear Sir:—

I found an advertisement of the Radio World. From this Specialty Magazine, I obtained exact technical information unobtainable and unpublished in other periodicals for many months.

The information meant \$42 cash in my hand.

This Section is primarily, in my opinion, a distinct service to readers; and secondarily an excellent market place for goods and service.

JOHN S. CRONT.

The Third Prize goes to Clay Lamberton, Jr., Berlin, Wis.

The Winners of the other seven prizes are Willard Burke, Springfield, Mass.; William Chapman, Whigham, Ga.; George Robertson, Franklin, Ky.; Arthur C. Anderson, Salina, Kans.; John Butcher, Grand Haven, Mich.; Homer Hoover, Wheelersburg, Ohio.; D. L. Colborn, Ingram, Pa.

Rate 25 Cents a Word. Advertisements intended for the April issue should be received by Feb. 5th

ADVERTISING

ADVERTISE in 24 metropolitan dailies, 24 words, \$15.00. Helpful Guide listing 1000 publications, 4c stamps. White Company, Baltimore Bldg., Chicago.

ADVERTISING rates for magazines and weeklies free. Charles A. Lutz, Apartment 241, York, Pennsylvania.

151 RURAL weeklies, \$6.04. Ad. Meyer, 4112 P.S., Hartford, St. Louis.

ADVERTISERS: Your 35 Word ad in 51 magazines \$2.00. Free Advertising Booklet, Auto-City Agency, 2747 Gladstone, Detroit.

DUPLICATING DEVICES

"MODERN" Duplicators save Time, Labor and Money. Gets business. Reproduces Typewritten or Penned Letters, Drawings, Lessons, Music, Menus, Bids, Notices, Specifications, Maps or anything in one or more colors. Prints two per minute. Special sale on 30 days' free trial, \$2.25 up. Booklet free. J. V. Durkin-Reeves Co., Pittsburgh, Pennsylvania.

"STENCIL Duplicating Outfit for Hand Use. \$1.00. On Approval. Prints Typewriting—Handwriting. Primos Specialty Co., 3-X, Primos, Pa."

TYPEWRITERS AND SUPPLIES

TYPEWRITERS all makes. Save one-half. Truly or-oughtly rebuilt in our factory by the famous "Young Process." Fully guaranteed. Free trial. We handle all standard makes. Cash or sold on easy terms. Write for Catalog. Young Typewriter Co., Dept. 5042, Chicago, Ill.

ALL makes, rebuilt, refinished and guaranteed ten years. \$15.00 up shipped privilege 30 days' time. Get our prices and agents proposition. Typewriter Manufacturers Exchange, Fordham, New York.

TYPEWRITERS sold on payments. Free trial. Payne Company, Rosedale, Kansas.

LABORATORY AND CHEMICAL

EXPERIMENTERS. Complete supplies for the chemical laboratory. Catalogue 5c. National Scientific Supply Co., 241 Pennsylvania Avenue, Washington, D. C.

YOUR chemical problem solved and working process furnished for five dollars. Write me. W. Steffman Richards, Consulting Chemist, Box 2402, Boston, Mass.

CHEMICAL Service. Formulas, analysis, methods, experiments. Jacob Shuyter, Chemist, 2527 East St., Davenport, Iowa.

CHEMICAL Processes, Analysis, Research, Technical Information. Consulting Chemists, Moulton, Maine.

FORMULAS

FORMULA catalog free. C. A. Lutz, Apartment 241, York, Pennsylvania.

3000 FORMULAS—400 pages—\$1.00 postpaid. Hillside Laboratories, 14802-D-Cooper, Harvey, Ill.

FORMULAS furnished—All kinds—Household recipes, Beverages, Chemical Magic. Universal Laboratories, Newark, Delaware.

ALL penetrating liniment, positively get the aches and pains of all kinds rheumatism, etc., Formula, \$1.00. Ace Laboratory 3421 Wabash, Chicago.

TATTOO'S removed, formula \$1.00. Artist's guide teaching tattooing, \$3.00. Catalogue free. Arttattooist, 1050 Randolph, Detroit.

FORMULAS—Guaranteed. Catalog free. Bestovall Laboratories, 4047-P.J., North Whipple, Chicago.

FOR THE HOME

GRANDFATHER clock works, \$5.00. Build your own case, instructions free; make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Nicetown, Pennsylvania.

GASOLINE lamps, lanterns and heaters. Catalog free. Little Wonder Mfg. Co., Terre Haute, Ind.

WANTED

DETECTIVES—Excellent opportunity. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

TYPISTS—Earn \$25-\$100 weekly in spare time copying authors' manuscripts. Write R. J. Carnes, P-I, Tallapoosa, Georgia, for particulars.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

WANTED—TO BUY

CASH for old gold, silver, platinum, watches, diamonds, magneto points, gold crowns, false teeth, and other valuables. Merchandise returned if offer unsatisfactory. Busch Products, Dept. 55, 144 Fifth Ave., New York.

MAIL Old Gold, Silver, Platinum, Diamonds, Jewelry, Bonds, Thrift, Unused Postage Stamps, Etc. Money wired within one hour for valuables, held ten days, returned if unsatisfactory. Ohio Smelting Co., 315 Hippodrome Bldg., Cleveland, Ohio.

More Money Making Opportunities
on pages 10 to 27

Do Your Friends "Feel Sorry" for You?

YOU are meeting new people every day—on the street, in the home, at various functions indoors and out. Every time you are "invited" *some one* stands sponsor for you. Every time you attend a social gathering, a party, a dinner, a dance, *some one* believes, or at least hopes, that you will do and say the right thing.



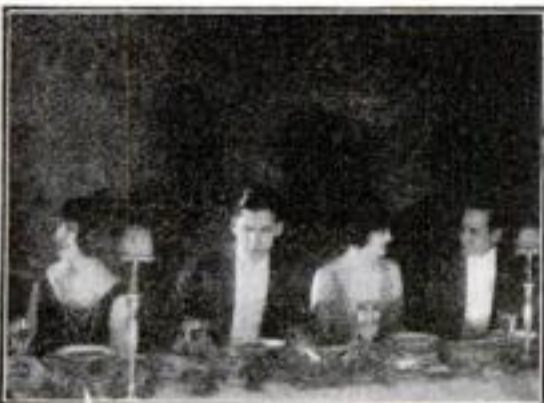
What's Wrong With This Picture?

Good breeding or the lack of it—is as quickly detected on the street as anywhere else. There are good manners and bad even in the simple matter of walking in public. Is it ever permissible for a man to take a woman's arm? When walking with two women, should a man take his place between them? Your ability to answer these questions is a fair test of your knowledge of what is the correct thing to do.



Shall She Invite Him In?

She doesn't know. They have spent a delightful evening together. Might they not prolong it a little? She would like to, and plainly so would he. But what should one do under such conditions? Should he ask permission to go into the house with her? Should she ask him to call at some other time? What does good usage say is the proper thing to do?



Are You Ever Tongue-Tied at a Party?

Have you ever been seated next to a man or a woman at a dinner and discovered that there wasn't a thing in the world to talk about? Does the presence of strangers "frighten" you—leave you groping desperately for words that will not come? When in the company of strangers, are you suddenly stricken dumb?

Do you live up to these expectations? Are you perfectly poised, self-confident, well-mannered, a delightful companion or guest—or must your friends secretly apologize for your awkwardness and lack of breeding? Must they *always* be making excuses for your mistakes in social deportment? Must they go on forever "feeling sorry" for you?

The person who knows the correct forms of social usage is never a source of discomfort or pity, either to his friends or to himself. He is never timid, "tongue-tied," ill at ease among strangers. He never finds himself stumbling and blundering at the very moment when he wants to make a good impression. Always calm, perfectly poised, sure of himself, he is never at loss for the right word, the proper action, no matter what unexpected condition may arise.

Are You a Welcome Guest?

To know what to do, say, wear, at all times and on all occasions, is to display those signs of gentle good breeding which people of culture and refinement approve.

Are you a welcome guest in the most highly respected circles? Do you know how to impress others with your dignity, grace and charm, whether in the theatre, on the street, at the dinner table, in the ballroom, wherever you may be? Do you converse smoothly and entertainingly? Do people seek you out, enjoy your company? Is your every word and act faultless, pleasing, beyond reproach?

The One Standard Social Guide

More than a half million people have found the Book of Etiquette the one authoritative, complete and acceptable guide to correct behavior and pleasing manners. Every phase of social intercourse is treated in detail in this remarkable two-volume set of books. Everything you want to know and should know is clearly and simply explained.

Do you know how to introduce men and women correctly? On what occasion, if any, a man may hold a woman's arm when they are walking together? How to take leave of the hostess after an entertainment? What to say to your partner in the ballroom after the music ceases? Whether olives should be eaten with the fingers or a fork? Whether a man precedes or follows a woman down the aisle at the theatre? Whether she may be left alone during an intermission? These are but a few of the hundreds of embarrassing problems which are solved for you in the Book of Etiquette.

Neither wealth, position, nor fine clothes can give you refinement of manner. But no matter what your station in life, you will be amazed at what a difference the priceless information contained in the Book of Etiquette will make in you.

If you want to make friends, be popular, mingle with the best people, and be invited everywhere, you cannot afford to wait another day to procure this remarkable set of books.



Nearly Half a Million Sold at \$3.50
NOW \$1.98
ONLY For a Very Limited Time

As a special inducement we are offering the famous Book of Etiquette in the regular \$3.50 edition at the special low price of only \$1.98.

You have always wanted to own this remarkable set of books. Now is your chance. We cannot extend this offer beyond the sale of a certain number of copies. Don't put it off and afterwards be sorry. Take advantage of this wonderful bargain right away.

Send No Money

Why not take advantage of our special reduced price offer and let us send you the Book of Etiquette right away? It will be sent you in a plain carton. You need send no money. Simply mail the coupon below. When the books arrive, pay the postman only \$1.98 (plus the few cents delivery charges), NOT \$3.50, the regular price. Read the books for five days, and if for any reason you are not satisfied, return them at that time, and your \$1.98 will be promptly refunded.

To be sure of getting the Book of Etiquette at the special price, clip and mail the coupon—right away.

NELSON DOUBLEDAY, Inc.,
Dept. 252, Garden City, New York

Nelson Doubleday, Inc., Dept. 252
Garden City, New York

You may send me, in a plain carton, the complete two-volume set of the Book of Etiquette. On arrival, I will pay the postman only \$1.98 (plus few cents delivery charges) instead of \$3.50, the regular price. It is understood that if I wish to return the books within five days, my \$1.98 will be promptly refunded.

Name.....

Address.....

☐ Check this square if you want these books with the beautiful full-leather binding at \$2.98 with same return privilege.
(Orders from outside the U. S. are payable \$2.44 cash with order. Leather binding, outside U. S., \$3.44 cash with order.)

ELECTRICITY

**Earn \$3500 to \$10000 a year
as an Electrical Expert**

What's Your Future?

Now you earn \$20 or \$30 or \$40 a week. In the same six days as an Electrical Expert you can make \$70 to \$200 and make it easier—not work half so hard. Why, then, remain in the small-pay game, in a line of work that offers no chance, no big promotion, no big income? Fit yourself for a “bossing” job—

Be An

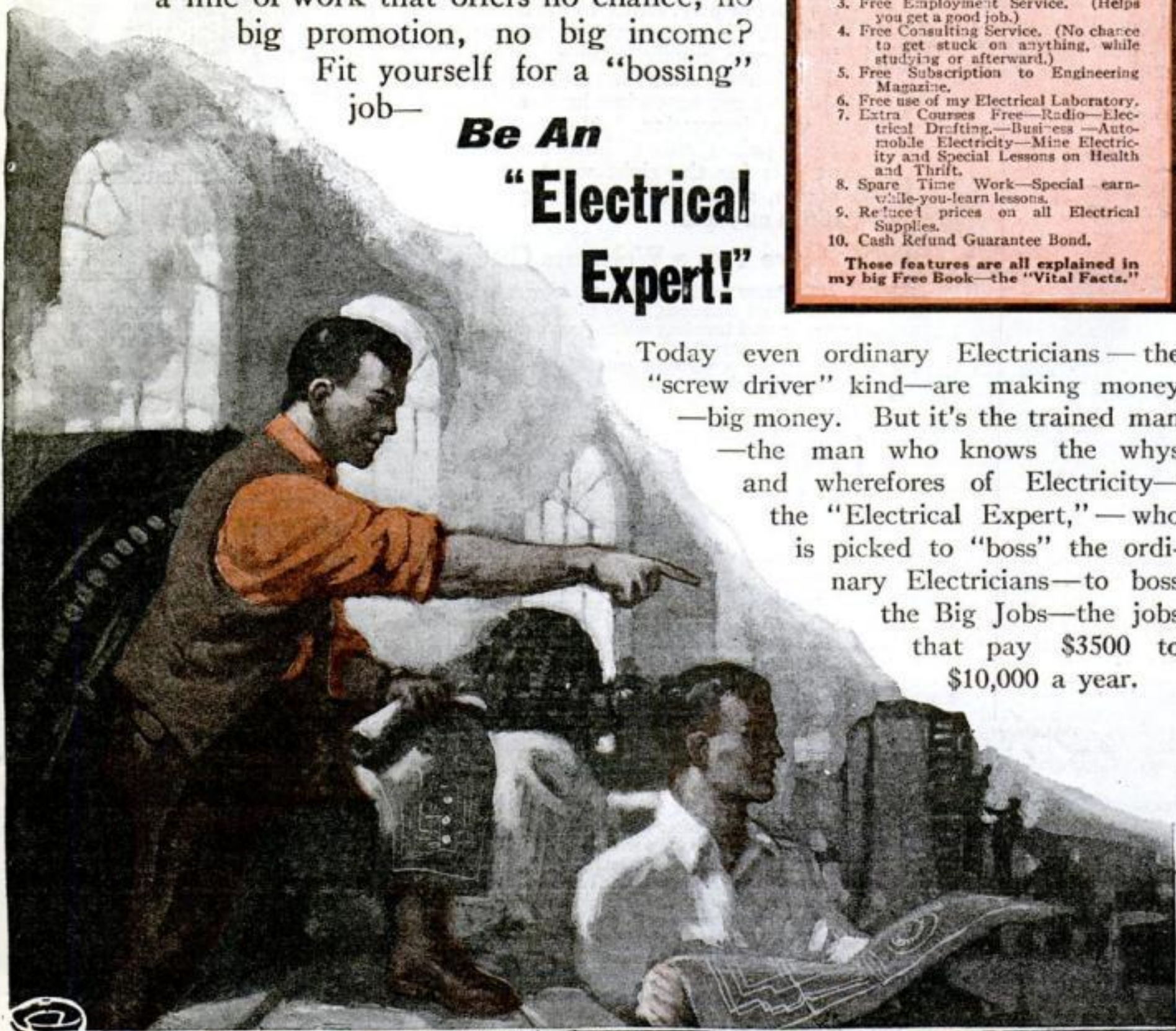
**“Electrical
Expert!”**

Some Features of Cooke Training That Make **SUCCESS** Certain

1. Practical Money-Making Instruction—no useless, high-sounding theory.
2. Free Electrical Outfit.—Finest outfit ever sent out for home experiment and practical use.
3. Free Employment Service. (Helps you get a good job.)
4. Free Consulting Service. (No chance to get stuck on anything, while studying or afterward.)
5. Free Subscription to Engineering Magazine.
6. Free use of my Electrical Laboratory.
7. Extra Courses Free—Radio—Electrical Drafting—Business—Automobile Electricity—Mine Electricity and Special Lessons on Health and Thrift.
8. Spare Time Work—Special earn-while-you-learn lessons.
9. Reduced prices on all Electrical Supplies.
10. Cash Refund Guarantee Bond.

These features are all explained in my big Free Book—the “Vital Facts.”

Today even ordinary Electricians—the “screw driver” kind—are making money—big money. But it's the trained man—the man who knows the whys and wherefores of Electricity—the “Electrical Expert,”—who is picked to “boss” the ordinary Electricians—to boss the Big Jobs—the jobs that pay \$3500 to \$10,000 a year.



The "COOKE" Trained Man is the

NEEDS YOU!

*I will train you at home
to fill a Big Pay Job*

\$3,500 to \$10,000 a Year

Get in line for one of these "Big-Pay Jobs" by enrolling now for my easily learned, quickly-grasped, right-up-to-the-minute, Spare-Time Home-Study Course in Practical Electricity.

Age or Lack of Experience No Draw-Back

You don't have to be a High School graduate—it isn't even necessary that you should have finished the grades. As Chief Engineer of the Chicago Engineering Works, I know exactly the kind of training you need, and I will give you that training. My course in Electricity is the most simple, thorough, successful and practical in existence, and offers every man, regardless of age, education, or previous experience, the chance to become in a few short months, an "Electrical Expert," able to make from \$70 to \$200 a week.

Earn While You Learn

With me you do practical work—at once. In my first few lessons I show you how to make money doing Electrical work in your spare time. (Over half of my students are paying for their course in this way.) I show you also, how to get started in business for yourself, and then help you to get started.

FREE—Electrical Working Outfit—FREE

To do spare time work you'll need tools, etc. These I give you,—Free—a whole kit including measuring instruments, a real electric motor (no toy), and other things—the greatest value ever given by any School.

Your Satisfaction Guaranteed by a Million Dollar Institution

I absolutely guarantee to return every penny paid me in tuition if, when you have finished my Course, you are not satisfied in every way with my instruction. And back of me, in my guarantee, stands the Chicago Engineering Works, a million dollar institution.

Nothing Like "Cooke" Training Anywhere

"Cooke" training is different because it's the most practical and most successful. It's best because it's backed up by the greatest Service to students ever known. It's this Service, plus "Cooke" training, that makes the "Cooke" trained man the "Big Pay" man everywhere. Become a "Cooke" Trained Man yourself, and earn \$12 to \$30 a day—\$70 to \$200 a week—\$3500 to \$10,000 a year.

Investigate! Mail Coupon

Get the Vital Facts. Let me send you free my big new book on The Future of Electricity. Let me tell you more about the big demand for "Cooke" trained Electrical Experts. Sign and send me Coupon below.

L. L. COOKE, Chief Engineer
Chicago Engineering Works, Inc.
2150 Lawrence Ave.

Dept. 32

CHICAGO, ILL.

"Big Pay" Man!



Send for
this **FREE**
book

The
**Vital
Facts**

mail this coupon NOW

L. L. COOKE, Chief Engineer,
Chicago Engineering Works, Dept. 32
2150 Lawrence Ave., Chicago, Ill.

Dear Sir:—Send at once the "Vital Facts" containing Sample Lessons, your Big Book, and full particulars of your Free Outfit and Home Study Course—all fully prepaid, without obligation on my part.

Name.....

Address.....

City and State.....

Occupation..... Age.....

CARPENTERS AND BUILDERS!

HERE ARE JUST THE PRACTICAL SHORT-CUTS
AND TRADE INFORMATION THAT YOU WANT



HOW TO HANDLE THE JOB THAT PUZZLES YOU—SHORT CUTS

How to use the different kinds of wood—complete detailed information on nails and screws—how to use the steel square—how to file and set saws—how to make wood joints—how to build furniture—how to make a mitre shooting board—how to plumb, and level work—how to lay out work—how to understand

carpenter's arithmetic—how to solve mensuration problems—how to estimate the strength of timbers—how to proportion beams—how to read plans—how to draw up specifications—how to estimate the cost of buildings—how to build houses, barns, garages, bungalows, etc.—how to build foundations—how to

proportion foundation footings—how to frame houses—how to set girders and sills—how to frame joists—how to frame a stud—how to set window frames—how to cut rafters—how to use the settings 12, 13, and 17 on the

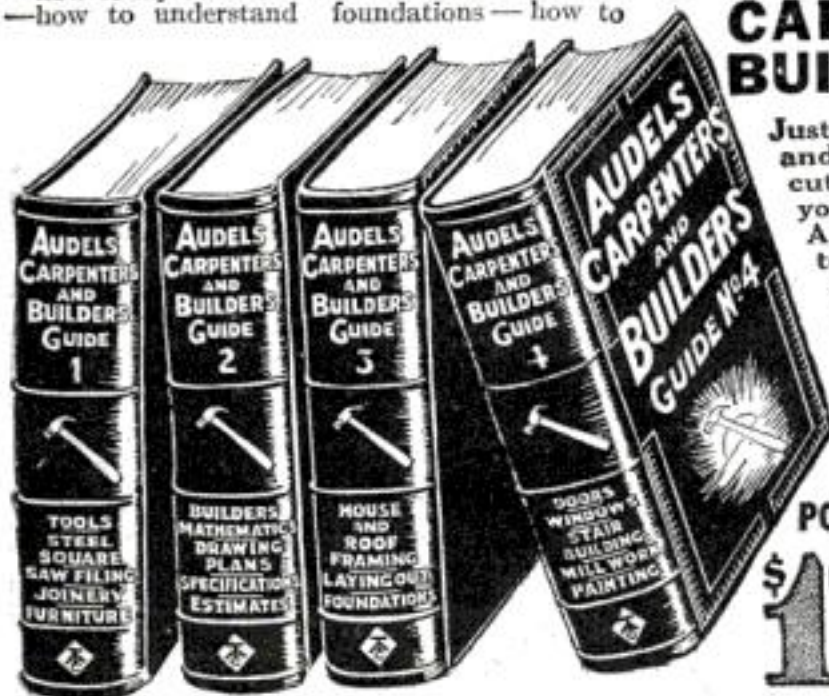
steel square—how to put on wood, fibre and metal shingles—how to hang doors—how to frame windows—how to put on sheathing—how to put on exterior trim—how to do cornice work—how to build stairs—how to lay floors—how to paint.

AUDEL'S CARPENTERS and BUILDERS GUIDES

Just available—Audel's Carpenters and Builders Guides—the short cut, professional information you want.

A Guide that keeps you in close touch with your work and shows you how you may increase your earning power.

No need to guess or take chances. Every day you have before you in this set, exact, practical, useful information to help you with your daily work.



POCKET SIZE FLEXIBLE COVERS

\$1 PER MONTH—ENTIRE SET \$6
Sixteen Hundred Pages
3700 Trade Illustrations

GUIDES EASY TO READ AND UNDERSTAND

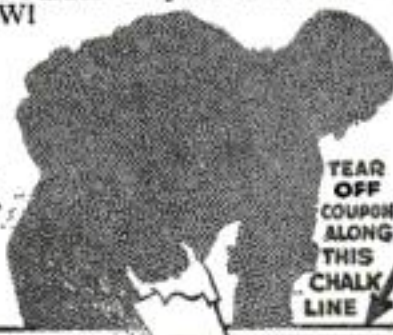
There are thousands of examples of modern construction and building work—new methods, new ideas, proved efficiency plans, short cuts, time saving suggestions, new ways that cover the entire theory and practice of modern carpentry. Every point is easy to read and

understand and clearly illustrated with sketches and forms. Decide for yourself whether they are worth the money to you. Pay only \$1 a month if you like them.

Return the Guides if you don't. Use **COUPON NOW!**

FREE EXAMINATION

Not a cent to pay until you see the books. No obligation to pay until you are satisfied. Send coupon now—today and get this fine, helpful new set for Carpenters and Builders. After you have looked them over 5 days send only \$1, then \$1 a month until \$6 is paid—if you want to keep them. Return them if you do not.



**SEND NO
MONEY**

SEND THIS COUPON ONLY

THEO. AUDEL & CO., 72 Fifth Avenue, New York City.

Please submit me for approval and free examination—AUDEL'S CARPENTERS AND BUILDERS GUIDES. Ship at once, prepaid, the 4 numbers. If satisfactory I agree to send you \$1 within five days and to further mail you \$1 monthly until \$6 is paid.

Name _____ Occupation _____

Address _____

Employed by _____ Reference _____

P. S. M.—2-24

Money Making Opportunities

INSECTS WANTED

WHY Not spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth \$1 to \$7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my Illustrated Prospectus before sending butterflies. Mr. Sinclair, Dealer in Insects, Dept. 7, Ocean Park, Calif.

MANUFACTURING

LET us make your wood toys, patterns, castings, or stampings, send specifications for our prices. Alvatab Manufacturing Co., Batavia, N. Y.

"DEVELOPING Ideas and manufacturing our specialty. Absolute satisfaction, 33 years experience; write us. The Eagle Way & Stop Signal Co., 2016 Elm St., Cincinnati, Ohio, Dept. C."

PRINTING, ENGRAVING, MULTIGRAPHING

BETTER Printing for Less Money. Write us about your printing needs, and you will save money. Ernest Fantus Company, 525 South Dearborn Street, Chicago.

EMBOSSED business, personal stationery. Samples, stamp. Daniels P. Company, Pittston, Pennsylvania.

225 BOND letterheads, envelopes, billheads, cards, \$1.25 each. Combination, \$4. Economic Printery, Leonia, New Jersey.

EVERYTHING Printed. Samples free. Franklin Press, B-34, Milford, New Hampshire.

CARDS printed, business or visiting, 50c per 100. C. O. D. postpaid. McMath Press, 403 East Seventh Street, Newport, Kentucky.

500 TWO Color Letterheads, \$2.75. Samples free. Superior, 1825 Roosevelt, Indianapolis.

QUALITY Printing 1,000 letter heads, envelopes, cards or statements, \$3.00. Your name on 200 note sheets and 100 envelopes, \$1.00. Samples Free. Howlett's, Paris, Ill.

500 EACH Hammermill bond letterheads, envelopes, \$4.50. Multigraphed letters \$4.25 thousand, delivered. Anderson, 205 N. Church, Rockymount, N. C.

LETTER Heads and Envelopes \$2.00 per 500. Samples. Roney's Printery, Paris, Mo.

NAME and address, 500, 30c. Others, in rolls or loose. Stationery, 200 sheets and 100 envelopes printed \$1.00. Eastern Label Co., Clintonville, Conn.

ADDING MACHINES

FREE trial, marvelous free adding machine. Adds, subtracts, multiplies, divides, automatically. Work equals \$350.00 machine. Price only \$15.00. Speedy, durable, handsome. Five-year guarantee. Used by largest corporations. Write today for catalog and free trial offer. Lightning Calculator Co., Dept. O, Grand Rapids, Michigan.

ADDING and calculating machines. All makes. Free trial. Year's guarantee. Shattuck, 424 Fourth Ave., Pittsburgh, Penna.

EDUCATIONAL AND INSTRUCTION

DOUBLE entry bookkeeping mastered in 60 hours; guaranteed; diploma. International Bookkeeping Institute, Springfield, Missouri, Desk 10.

LINCOLN-JEFFERSON University. Home Study in Academy College, Theological, Law, Music, Pharmacy. Business and Graduate schools, leading to degrees. Box G, 64 W. Randolph Street, Chicago.

HYPNOTISM easily learned. Lessons guaranteed. Postpaid \$1.10. Smith Publishing Co., Springfield, Mass.

SHORTHAND in 100 hours. Most rapid readable system. Introductory booklet, free. Memorscript Institute, Roanoke, Virginia.

USED correspondence courses bought and sold. Bargain catalogue 1000 courses free. Students' Exchange, Dept. 3, 47 West 42d Street, New York.

ARITHMETIC lessons by mail at small cost. Burket, Roosevelt Ave., Roaring Spring, Pa.

HOMESTUDY. Shorthand, Typewriting, Law. Secretary, 1552 Broadway, Grand Rapids, Michigan.

PERSPECTIVE drawing made easy. Fuller Simplified System makes beginners and junior draftsmen expert overnight. Send stamp for particulars. Earl Fuller, 103 Gumble Bldg., Kansas City, Mo.

OVER 100 Home Study Courses—Tuition Free. Apply Carnegie College, Rogers, Ohio.

MAIL ORDER BUSINESS

\$50 a week, evenings. I made it. Mail order business booklet for stamp tells how. Sample and plan 25c. Free, 12 articles worth \$3. Alps Scott, Cobos, New York.

PRUITT'S Mail Order Opportunities and Money Making Magazine, 10c. 2750 Lister, Kansas City, Mo.

NEW names and addresses. Guaranteed correct. J. Benson, Thorpe, Wis.

LETTER SPECIALISTS

SELL your services with a natural, sincere, convincing letter of application. Seven master letters—forceful—distinctive—real position-getters with complete instructions, \$1.00. Hines Letter Service, Dept. A, 1215 Capitol Bldg., Chicago.

POULTRY

FOUR new money making fowls, Spencer Turken, Russian Orloff, Jersey Giants and New Zealand Kiwi. Complete information free. Spencer, Route 1, Santa Cruz, Calif.

**More Money Making Opportunities
on pages 6 to 27**



*Hair roots often are
not dead, but
dormant*



*Merke Treatment
penetrates to
hair roots*

Free Proof — My New Method Grows Hair!

Actual Results

Scores of Other Letters
Tell the Same Story

Hair Growth After 3 Weeks

"Your treatment so far is nothing short of being wonderful. New growth started after three weeks' treatment. Dandruff entirely gone. Scalp is loose, healthy and am on the way to a new head of hair. My fears of baldness are gone forever. You may use my name and testimonial."—A. McK., Lakeview, N. J.

Hair Almost Gone

"I have now used your treatment 2 months, and although I nearly lost my hair entirely and have been bald for 8 years, I was much surprised to see the improvement it has made for me in this short time. I think ten times the price of what I paid for it would not be any too much for it."—N. R. B., Glen Cove, N. Y.

Results Very Gratifying

"I have used your Thermocap Treatment for 8 weeks and although the top of my head has been entirely bald for 6 years, the results up to the present are very gratifying. In fact, the entire bald spot is covered with a fine growth of hair."—W. A. C., Kenmore, O.

Bald For Years

"Kindly allow me to praise and recommend the wonderful Merke Treatment to any one who may be looking for a hair treatment which positively shows quick results. After 5 weeks' treatment a new growth of hair has shown on each side of the temple where I have been bald for years."—C. B., New York City.

Does Everything Claimed

"Am glad to say I can see such great change in my hair. It is growing longer and my head is full of young hair that has made its way through since I have been using Merke Treatment. I can't say enough for it. It will do everything you claim it to do."—Mrs. G. G., Houston, Tex.

New Hair in 20 Days

"Have been using Merke Treatment 20 days and have received great results. My hair has been falling out for 4 years and your Treatment has checked it. I had two bald spots on my head where there was not even any fuzz, and there is new hair growing on them now. I wouldn't take \$50 for the Merke Treatment. I think it's the best in the world."—J. M., Smackover, Ark.

Thousands of men and women have grown hair through my new method! It is guaranteed to grow hair for YOU—or your money will be instantly refunded! Mail coupon today for full details—and free proof of how this method promotes hair growth



No matter how nearly bald you are—no matter how many treatments you've tried without success—let me send you, without the slightest cost or obligation, full information on my new discovery. Let me mail you actual figures, facts and photos which show conclusively what my treatment is and what it does.

My new discovery is the result of 17 years' experience I've had in treating baldness, which included long years in Heidelberg, Paris, Geneva, Cairo, Berlin and other centers of scientific research. At the Merke Institute, Fifth Avenue, New York—which I founded—many people have paid as high as \$500 for results obtained at home—and for only a few cents a day!

You can now avail yourself of my home treatment, on my absolute guarantee to grow hair or no cost.

My Guarantee

I appreciate that most people are skeptical of claims to grow hair. I don't blame them. I don't say that my treatment will grow hair in every case. There are some cases of baldness which nothing in the world will help. But I *do* know that it has already grown hair for thousands. And I *do* know that it has banished falling hair and dandruff for hundreds of others—almost instantly.

That's why I'm so confident that it will do all of this for you. Read the letters printed on this page and you'll realize why I am willing to have you try my treatment entirely at my own risk. Then—after 30 days—if you're not more than delighted with results—if you cannot actually see a new growth of hair—then all you need do is to tell me—and without the slightest delay or question I'll mail you a check refunding every cent of your money. *I don't want your money unless I can actually grow hair on your head—and you are the sole judge of whether or not it grows!*

Entirely New Method

My method is entirely different from anything known or used before. There is no massaging—no singeing—no "Mange cures"—no unnecessary fuss or bother of any kind. Yet results are usually noticeable after the very first few treatments.

My treatment proves that a big percentage of baldness even of years' standing is caused—not by dead hair roots—but by dormant hair roots which now can be awakened and made to grow again. Already scores of men and women who suffered for years from falling hair and partial baldness, have acquired a thick, healthy growth of hair through this amazing method, which for the first time provides a way of penetrating to the hair roots and furnishing nourishment direct to them.

Free Booklet

If you will merely fill in and mail the coupon below I will gladly send you—without cost or obligation—an interesting 32-page booklet describing my treatment in detail—and free proof of its effectiveness.

This book contains much helpful information on the care of the hair—and in addition shows by actual photographs what my treatment is doing for thousands of others.

If you are bald—or if right now you are merely troubled with falling hair and dandruff—this free booklet will prove to be of the greatest value to you. So mail the coupon now—and it will be sent you without cost or obligation by return mail.

ALLIED MERKE INSTITUTES, INC., 512 Fifth Avenue, Dept. 172, New York City

ALLIED MERKE INSTITUTES, INC.
Dept. 172, 512 Fifth Avenue, New York City

Please send me, without cost or obligation on my part, a copy of the new booklet describing in detail the Merke Institute Home Treatment.

Name.....
Address.....
City..... State.....



Be An **AUTO EXPERT**
Make \$75 to \$200
A WEEK

**Learn
at Home
to Boss
the Job**

B. W. COOKE
Directing Engineer
Chicago Auto Shops



I WILL make you a successful **AUTO EXPERT**, prepare you to go into business for yourself, train you for positions paying \$3,000 to \$10,000 a year. Keep your job, stay home—just loan me a part of your spare time. As Directing Engineer of the big **CHICAGO AUTO SHOPS**, I train you the "JOB-WAY"—not with books. Go into the best-paying business on earth—get your share of the thousand million dollars spent every year to keep Autos, Trucks and Tractors running!

**I Train
You**

AT HOME!

Schools make Auto Mechanics—my home-training makes Auto **EXPERTS!** I prepare you to **BOSS THE JOB!** My "JOB-WAY" instruction makes you **MASTER** of every branch of Automobile work—Mechanical, Electrical, Battery, Taxicabs, Busses, Ignition, Farm Power plants, Welding, Brazing, Vulcanizing, etc. You cannot get all this training anywhere else on earth.

Start Now! I'll help you start, help you succeed!

Inducements you cannot resist right now to ambitious men. Easy terms, within reach of anybody. Many Free features. Coupon brings your greatest opportunity—mail it to me right away!

B. W. COOKE, Directing Engineer

CHICAGO AUTO SHOPS

Dept. 225, 1553 W. Madison St., Chicago

B. W. COOKE, Directing Engineer
Dept. 225
1553 W. Madison St., Chicago

Please send me Free Book and complete information about your "Job-Way" training at home. Tell me about the opportunities today for Auto Experts. I am mailing this promptly to secure **FREE REPAIR OUTFIT** and the reduced prices and special terms you offer now. Of course, I am not obligating myself in any way.

Name.....
Address.....
City..... State.....
Occupation..... Age.....

MAIL COUPON TO DAY

**AUTO BOOK
FREE!**

**AUTO
EXPERTS
WANTED AT
\$3,000 to \$10,000
a year!**

The "best-paying business on earth" is hungry for **EXPERTS!** Where else can you find such opportunities as in **AUTO** business! 15 million Autos, Trucks and Tractors to keep going, 50 million tires to repair, 15 million starting, lighting and electric systems to maintain, 15 million batteries to service and replace. *Man alive!* Wake up to this rich money-making opportunity!

GO INTO BUSINESS!

**Make \$5,000
to \$15,000 a year!**

There are thousands of opportunities to go into business for yourself, with small capital. Auto Experts run big service stations, make up to \$15,000 a year! The same wonderful opportunity is waiting for you. My "Job-Way" instruction prepares you for it.

**My "Job-Way" training makes successful
high-price AUTO EXPERTS!**

FREE OUTFIT

Big repair and testing outfit free to my students. Mail coupon for my remarkable offer. Use it to do my **JOBS**, use it to make money, use it to make this training pay for itself!

FREE JOBS

My big Employment Department helps my graduates to get big pay jobs without one penny of cost.

\$25.00 in PRIZES

See top of page 6 in front of book for details

WANTED

Railway Postal Clerks

\$1600 to \$2300 Year

MEN—BOYS 18 UP

MAIL COUPON IMMEDIATELY

Steady work. No layoffs. Paid Vacations.

Common education sufficient.

Travel—See your country

FRANKLIN INSTITUTE, Dept. E278, Rochester, N. Y.

Sirs. Send me without charge, (1) Sample Railway Postal Clerk Examination questions. (2) List of Government jobs now obtainable. (3) Send free illustrated book, "How to Get Government Jobs"

Name.....

Address.....

Money Making Opportunities

MUSIC AND SHEET MUSIC

POEMS wanted—Sell your song verses for cash. Submit MRS. at once or write New Era Music Company, 117, St. Louis, Missouri.

COMPLETE, easy self-instructors—Harmonica, Violin, Piano, Drum, Ocarina, Ukulele, Accordion, Saxophone—25c each. Elsea, Publisher, Bowling Green, Ohio.

WRITE the words for a song. We compose music. Our chief of staff wrote many big song-hits. Submit your song-poem to us at once. New York Melody Corp., 4194 Romax Building, New York.

A \$500.00 Cash Prize is offered for the best second verse written for the song "Remember." Those wishing to compete may receive a free copy with rules by addressing Equitable Music Corporation, 459, State Theatre, N. Y.

PERSONAL

50 "FUNNY" parodies on latest songs, "Yes! We Have No Bananas" etc., 25c. P. S. Collins Co., 197 Fulton St., Brooklyn, N. Y.

ARE you old at forty? See our advertisement on page 144 of this issue. The Electro Thermal Company, 4029 Main St., Steubenville, Ohio.

REFERENCE ALBUMS

WONDERFUL Reference Album, lays and stays flat when opened, will bind large quantity clippings, papers, etc., on gummed hinges, 3 sizes: Fabricoid Cover: 16" x 11½", \$3.50; 11½" x 10½", \$3.25. Pressboard Cover 11½" x 10½", \$1.25. Write for particulars of other up-to-date filing devices. Zeta-Be Company, 30 East 42nd Street, New York City.

FOR BOYS

THREE foot model aeroplane. Small cost. Circulars free. Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.

NEW bird wing flexible glider, daring, thrilling. Complete blueprint and instructions. Postpaid, \$2.00. A. C. Dirks, P. O. Box 146, Pipestone, Minnesota.

PATENTS FOR SALE

CAPITAL Wanted—"Queer" new power. Patent applied for. Hart Machine and Tool Co., Atlantic Ave., Boston, Mass.

FOR Sale. An Electro-Mechanical Alarm Patent. Cheaply made and the world in demand for it. Hold rights in Canada, and expect to get the issue from United States in a short time. Drawings on request. Write J. S. Prowse, Post Office Box 748, Kansas City, Mo.

OFFICE DEVICES

ADDRESSING machines, multigraphs, duplicators, folders, check writers, sealers, dictating machines, at about half new cost. Pruitt, 170-Z North Wells, Chicago.

RAZORS AND BLADES

BLADES, resharpened, 3c, any make; guaranteed service. Standard Safety Razor Corp., Pittsburgh.

HOME WEAVING

HOME weaving—looms only \$9.90. Big money in weaving rugs, carpets, portieres, etc., at home, from rags and waste material. Weavers are rushed with orders. Send for free loom book, it tells all about the weaving business and our wonderful \$9.90 and other looms. Union Loom Works, 482 Factory St., Boonville, New York.

DISTRICT MANAGERS WANTED

WORLD'S fastest selling auto accessory! County distributors wanted; write today. G. L. W., Spring Oiler Co., San Diego, California.

DOGS AND PETS

AIREDALES that I breed people appreciate. Dr. Knox, Danbury, Connecticut.

ROOTS AND HERBS

GINSENG and other Plants for Medicine, Perfume, Dyes. How to gather. Buyer's Addresses. Book 30 cents. O. Twitchell, Berlin, N. H.

HOROSCOPES

YOUR horoscope, business, changes, social, matrimonial prospects. Send birthdate and 10 cents (stamps) for remarkable test reading. Zanya, 202-B West 105th Street, New York.

UNUSUAL HOROSCOPE—Six pages, consisting of extensive four-page Special Horoscope, Astro-Analysis and two-page valuable guide giving daily and monthly advice covering entire year. Send 50c and birthdate. Money returned if dissatisfied. Prof. T. Bolles, Box 5, Fordham Station, New York, N. Y.

THE "Divine" purpose of the year 1924 in your life, revealed according to the "Pythagorean" system of letters and numbers. Send twenty-five cents in stamps and your birth date. "Hagermath" P. O. Box 16, Station Y, City of New York.

TRADE SCHOOLS

PAINT Automobiles, Trim Automobiles, Become a Certified Electrician, Auto Battery Builder, Ignition Expert on Starting and Lighting, Metal Finisher, and a complete course in Auto-Repairing, Bricklaying and Plastering. We fit you for a big money job. Make you an expert able to step right into a position paying \$45 to \$100 per week. You are paid while Learning. We maintain our own Dormitories. Come to Detroit, the Automobile hub; the World's wonder City. Write today. Standard Trades School, 416 Woodward, Detroit, Mich.

**More Money Making Opportunities
on pages 6 to 27**

A New and Sensational Discovery

A Million Dollar Secret

A New Joy

This new and startling discovery of a supreme natural law of life, health and pleasure is joyfully revolutionizing the lives of thousands of men and women all over the world. It is bringing them a new kind of pleasure, happiness, health, strength, confidence, energy and power of personality and success. It is giving them such marvelous energy of mind and body, and they enjoy life so fully, so intensely, so dominatingly, and so thoroughly, that the old life to which they were accustomed appears totally inferior in every respect.

The possession of this new and mysterious natural law gives a new idea of how truly vital, alive, joyful, healthy and happy a human being can be—how easily one can be overflowing with life, energy, bubbling vitality and the fire of triumph. Although thoroughly natural and simple, nevertheless it accomplishes seemingly impossible results without sacrifice, active effort or cost.

A new life with a unique thrill is yours when you possess this newly discovered natural law of supreme life, health and pleasure. It is no longer necessary for any one to spend money for treatments and drugs and dieting and books and pills and devices, because perfect and supreme health and life are absolutely free through this marvelous natural law.

Why be weak, why be ill, why be fat, why be thin, when you may, absolutely free, become in every way perfect and supreme through this sensational natural law?

This extraordinary natural law yields amazing nerve force, amazing energy, amazing vitality and amazing power of every character of mind and body—a new and superior life.

Through this sensational natural law you may have all of the benefits of exercise without exercise; all of the benefits of conscious deep breathing without conscious deep breathing; the full and complete benefit of every vitamine and organic iron without drugs or dieting; all of the benefits of medicine and drugs without medicine and drugs; all of the benefits of auto-suggestion, hypnotism and psychology without auto-suggestion, hypnotism and psychology; all of the benefits of dieting, and every other kind of



treatment, device or assistance without these treatments.

Through this amazing natural law, anyone can rid self permanently of every human weakness. This unique natural law gives immunity from every disease of the inferior life. No matter who you are, this natural law can demonstrate to you that you do not yet know the full meaning of joy, pleasure,

happiness, vitality and gratification. This natural law is ready to give you a new realization of the meaning of life and enjoyment.

This extraordinary and Universal Law does not require you to actively do anything or give up anything. It requires no exercise, no time, nor conscious deep breathing—no stretching, dieting, drugs nor medicines.

This natural and supreme law must not be confounded with hypnotism, auto-suggestion, psychology, spiritual science, psychic science, science, mental science, nor with electricity, osteopathy or any other method—mental or physical—ever devised in the past.

No self-hypnotizing phrases to repeat—no yielding, no recession, no giving up of anything, nothing to study, nothing to actively practice, no books to buy, nothing to memorize, no self-deception—nothing but truth—reality—Natural Law.

Perfect health cures every known and conceivable disease. This startling natural law is guaranteed to give perfect health.

If you are not enjoying life to the full—if you are in any way handicapped—if you are not in possession of all of

the powers of mind and body to the highest degree, you owe it to yourself to at once procure for yourself free of charge this revolutionary natural law. Through this supreme natural law, anyone may have the health and vitality of a lion or tiger.

Remember that demonstration and results are immediate and free.

This powerful natural law transforms the gloom of disease into the bloom of health, as the rays of the spring sun transform the dead soil into a "sea" of luxuriant vegetation. It is destined to revolutionize human health and happiness—Humanity.

This natural law is most marvelous, most simple, most subtle, and most powerful. It is the Law of Creative Power.

Remember there is nothing active to do, nothing to study, nothing to believe, no time to waste, no habits to give up, nothing to lose—there is no mystery—it is merely Natural Law. This secret is offered to you absolutely free. There are no "conditions" or "strings" attached to this offer.

You would not be without this secret if you could imagine how delightfully transformed your life would be through the possession of this new and deeper realization of happiness, pleasure, joy and gratification.

Anyone—male or female—above eighteen years of age is eligible to receive this marvelous secret absolutely free.

Swoboda has a priceless secret for every human being who wishes to be happier, healthier, more vital and successful in a new degree.

**Alois P. Swoboda, 1211 Berkeley Building
21 West 44th Street, New York City**

Send me free the Swoboda Natural Law of Supreme Life and Health.

To help cover cost of publishing and mailing, I enclose postage. (Not more than ten cents, please.)

Name.....
(Write Plainly)

Address.....

City..... State.....

Publisher's Note:—Many individuals who have obtained this secret claim it is absolutely priceless—worth millions.

Look Here!

I WILL MAKE
you a
Drafting Expert!



If you're earning less than \$100 a week, GO INTO DRAFTING! I guarantee to train you AT HOME the JOB-WAY, with actual Drafting Room jobs. Send for my free book, find out about the wonderful opportunities to earn big money in this easy, fascinating business. Drafting Experts are close to the Boss, are first in line for promotion to Executive positions.

\$250 to \$400 a Month!

Common schooling all you need! I train you by my copyrighted "JOB-WAY" instruction. I cover every branch of Drafting by giving you actual JOBS to do. No books or useless theory to waste your time. My graduates are SUCCESSFUL—employers prefer Coyne-trained Draftsmen. So I guarantee to make YOU an EXPERT or to refund your money!

Learn at Home! Thousands of big-salaried jobs all over the country looking for DRAFTING EXPERTS! Railroads, factories, builders, architects, ship yards, auto plants, Cities, Counties, States, and the U. S. Government all calling for Drafting Experts, all waiting for you to start and finish!

Chief Draftsman,
COYNE SCHOOL OF DRAFTING,
Dept. 237, 1-9 S. Ashland Ave., Chicago.

Without obligating me in any way please send me your book, "Drafting, the foundation of industry" absolutely free. Also complete information of your rapid home-study Drafting course and Free Instruments.

Name
St. No.
City State

Drafting Book Free!

Mail coupon, get my free book. Let me tell you the rest of this story personally. Address

CHIEF DRAFTSMAN
Coyne SCHOOL of DRAFTING
Dept. 237,
1-9 S. Ashland Ave.
CHICAGO



FREE!
EXPERT'S
Drafting Outfit
"JOB - WAY" training make you a DRAFTING EXPERT quick because you learn to do actual JOBS with the same instruments you will use when employed at a big salary. To encourage you to START RIGHT NOW, I will give you with my course this complete EXPERT'S outfit FREE. Coupon brings complete information.

Money Making Opportunities

BOOKS, PERIODICALS

"LIGHTS, Colors, Tones and Nature's Finer Forces," including vibrations; odic auras; cold-lights; radio; inventions; illustrated; 276 pages, \$2.00. Circulars free. Stevens Science Publishers, 242 Powell St., San Francisco.

CURIOUS books, unique novelties, stunning pictures. Samples and illustrated list, 10c. I. P. Lind, 214 W. 34th St., New York.

DISEASES and their innate healer, 50c. Arthur Stevens, Wauseon, Ohio.

X-Woundmarked Seer Emmerich, Nativity, Egypt, Cana; 4 books for 20c. Klein Co., Brandon, Minn.

KNEIPP Sanitarium, Minneapolis, Minn., Free books on health and vigorous manhood.

PLAYS AND ENTERTAINMENTS

YOU'LL have lots of fun exchanging cheery letters in my club. Eva Moore, Box 908, Jacksonville, Florida. (Stamp.)

PLAYS, musical comedies and revues, minstrel music, blackface skits, vaudeville acts, monologs, dialogues, recitations, entertainments, musical readings, stage handbooks, make-up goods. Big catalog free. T. S. Denison & Co., 623 So. Wabash, Dept. 26, Chicago.

EXCHANGE interesting letters with new friends. Dolly Gray Club, Box 186J, Denver, Colorado.

AUTHORS—MANUSCRIPTS

WRITE: for newspapers and magazines. Big pay. Experience unnecessary, details free. Press Reporting Syndicate, 400, St. Louis.

WRITERS—Stories, poems, plays, etc., are wanted for publication. Literary Bureau, 117, Hannibal, Missouri.

FREE to writers—a wonderful little book of money-making hints, suggestions, ideas; the A B C of successful story and play-writing. Absolutely free. Just address Authors' Press, Dept. 15, Auburn, New York.

BIG money writing photoplays, stories, poems, songs. Send for free copy America's greatest magazine for writers. Tells you how to write and sell. Writer's Digest, 636 Butler Bldg., Cincinnati, Ohio.

\$\$\$ FOR Ideas. Photoplay plots accepted any form, revised, criticized, copyrighted, marketed. Advice free. Universal Scenario Corporation 214 Security Bldg., Santa Monica and Western Avenue, Hollywood, California.

MISCELLANEOUS

HOMEOPATHIC and Biochemic preparations sent postpaid to all parts of the world. Manual and booklets free. Halsey Bros. Co., 111 N. Wabash Ave., Chicago, Illinois. Established 1855.

BRITISH girls desire American correspondents. Proposition 10c. Clack, 16 Cambridge St., London, S. W., England.

MAKE interesting new friends through jolly letters. Betty Lee, Inc., 4254 Broadway, New York City. Stamp appreciated.

LONESOME—Join our club—make acquaintances everywhere. Big illustrated book with descriptions and photos, sent in plain wrapper for ten cents. Bonafide Co., Dept. 43, Kansas City, Missouri.

ARE you old at forty? See our advertisement on page 144 of this issue. The Electro Thermal Company, 4029 Main St., Steubenville, Ohio.

CREATE international friendships. Magazine, information 5c. Write: "Universalist," 1034A West Eighteenth St., Chicago, Ill.

THE Key to Power points the way to success, health, happiness and independence. Banish fear, mystery, confusion, failure, etc. Valuable information free. Louis L. Stransky, Elberon, Iowa.

FOR MEN AND WOMEN

"SEXUAL philosophy," 12c. Clear, specific authoritative, complete, best, astishes. Fred B. Kaessmann, Lawrence, Massachusetts.

GENUINE Indian baskets, blankets and wampum—wholesale. Catalogue. Gilham, Keseyville, California.

MAGIC words! Secret, sure method of obtaining anything you want. Postpaid for dime. Lida Smedley, 145 Miller, Brooklyn, New York.

DETECTIVES—Work home or travel. Experience unnecessary. Write American Detective System, 1968P Broadway, New York.

A CERTIFICATE for \$10.02 Free. For particulars write Orient Supply Co., North Troy, N. Y.

ARE you old at forty? See our advertisement on page 144 of this issue. The Electro Thermal Company, 4029 Main St., Steubenville, Ohio.

FARM LANDS

BUY These Bargains by Mail. \$73 for 12 acres, choice lake frontage; \$75 for 25 acres, trout stream—accessible; \$97 for 50 acres, beautifully wooded—abutting; \$105 for 50 acres, hunting camp site; \$49 for small acreage, Georgian Bay; \$125 for good acreage, big game district; \$215 for large acreage, hunting camp site; \$285 for mining claim, may be worth a million. Also beautifully situated hunting camps and fishing lodges, where there is real hunting and fishing. Summer cottage sites, islands of all sizes, heavily wooded acreages all situated in Muskoka, Georgian Bay District with its ten thousand islands. Algonquin Park with its 300 lakes, Highlands of Ontario, Lake of Bays and the famous Muskoka Lakes region. All offered at 10 cents on the dollar of their value and on easy monthly payments of \$5.00 and upwards. Send for illustrated list of the above and one hundred other properties seized and sold for taxes. If you are interested in the forthcoming boom in Canadian Gold and Silver mines, and would like a mine all your own for two or three hundred dollars send for list 240A. Every property is fully described and offered at a stated price. Send no money. Send for list today, so you will have first chance. If you wish you may make the payments to your local trust company. Tax Sales Service, 72 Queen Street, West, District 17, Toronto, Ontario, Canada.

More Money Making Opportunities
on pages 6 to 27

RADIO
BIG MONEY IN A BIG FIELD
Wanted—and wanted quick are men who can qualify for big pay positions in the enormous, fast growing Radio Industry. Once in a lifetime chance. Fast, easy to learn. No previous experience needed.

Be A Radio Expert
\$3,000 to \$10,000 a Year

Learn at home, by actual practice, to design, construct, install, operate, repair and sell Radio Equipment. Pleasant, fascinating, profitable. My methods are simple, clear and successful. Turn your spare time into cash.

FREE WONDERFUL 1000 MILE TUBE RECEIVING SET. Write today for Booklet "Radio Facts" FREE.

L. S. Nohsest, Radio Eng., American Radio Association
4513 Ravenswood Ave., Dept. 42, Chicago

Music Lessons At Home

With Celebrated Teachers

Our simplified courses are specially prepared for home study. Not a new method. Long established School now celebrating its 20th Anniversary. Send for Illustrated Catalog. Every person who loves music should read this free book. Write which instrument you have. Get details of the lessons and our Anniversary Offer—one which means a cash credit on your tuition. Courses, endorsed by Paderewski: Piano, Harmony, Voice, Public School Music, Violin, Cornet, Mandolin, Guitar, Banjo, and Reed Organ. Careful training by Faculty in grading examinations makes the instruction personal for each individual pupil. See for yourself what others have done. You can be sure of same results.

UNIVERSITY EXTENSION CONSERVATORY
876 Siegel-Myers Bldg. Chicago, Illinois

Great Inventors Now Teach You Secrets of Practical Inventions

How would you like to be the inventor of the tin cap that now corks millions of bottles—and who gets a royalty on every one? How much money would you have now if you had invented the simple idea of putting a rubber tip on pencils? The inventor of the Gillette Safety Razor is said to have made as high as \$2,500,000 a year! The inventor of the tiny snap fastener last year paid an income tax of \$29,000. The man who invented the Autographic Kodak sold his patent rights for \$500,000!

JUST a single idea can make you independently wealthy in a short time. Little things—like the crimped hairpin, the paper safety-match, the metal-tip shoe-lace—brought their inventors hundreds of thousands of dollars. Only recently *Success Magazine* told how one woman built up a splendid business from an invention based on a little wedge-shaped piece of wood!

Couldn't you develop an invention as simple as these? Haven't you some ideas—even now—for one of these little inventions which can pay you so much money?

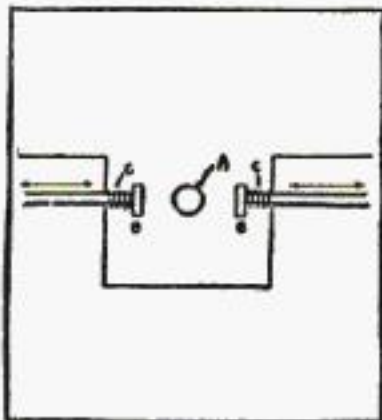
What Invention Is

After all, invention is nothing more than the science of "fixing things." And how many times a day you do "fix things." A leaky faucet, a rattling window, a broken strap—you fix hundreds of things just like these almost every day. You may not know it, but when you "fix things" you are using the principles upon which Inventive Science is based.

Prove it for yourself. Here is shown a very simple problem in invention. See how quickly you can solve it. What would you put on Shaft "A" to force members "B B" to move back? Think of something you know now which can give you the answer. If you have an ordinary electric light switch you will find it in a second.

Invention is not guesswork or blind luck—it is not a God-given faculty possessed by a few favored mortals. The truth is that invention is based upon exact laws which anyone can learn. It is merely a matter of first seeing something to be fixed and then of thinking of some principle which will fix it.

This test shows how easily you can develop your ability to invent.



Here is an interesting little problem and its solution will be found very simple, if we really think hard.

"A" is the end of a shaft. The two members "B B" are free to move in either direction indicated by the arrows. If they are pushed back, the springs "C C" will immediately pull them forward again. Our problem is to put some kind of an attachment on the revolving shaft "A" so that the members "B B" will be pushed back both at the same instant every time the shaft "A" makes a single revolution. The device on shaft "A" must also allow the two members "B B" to come forward once in every revolution. What would you suggest putting on the shaft "A"?

That's all. The whole thing rests on being able to think inventively. The simple problem shown here proves that when you think inventively the whole science of invention becomes as easy to learn as reading or writing.

Why More Inventions Are Needed Now

Hundreds of years ago, the world didn't need many new things. That is why few inventions were made each year. But now the world has more needs, more things to be "fixed." And that is why, in the United States alone, over 50,000 inventions are patented every year!

The world wants better and cheaper light and power. It wants an electric light that will be heatless. It wants new motors that will weigh less and produce more power. It wants faster and less costly aeroplanes, motor cars, steam engines. It wants new inventions which will make cooking and housework easier; that will save time and labor in the home, the farm, the factory and the office. It wants new ideas for toys and other amusements. It wants its present inventions to be developed so that they will work better and more economically.

Surely you have at least one idea for an invention—no matter what it is—no matter how great or how small—the world will pay handsomely for even the simplest idea. Every day you see things which can be improved or which must be "fixed." Every day you can get ideas for new inventions. It can be a new kind of mechanical toy, or some device which will make your wife's housework easier. It can even be something as simple as the common nutcracker. The man who invented the Kiddie-Kar, it is reported, made over \$5,000,000!

What Edison Says

Could you ask the advice of any greater authority than Thomas A. Edison? He says: "INVENTION IS A SCIENCE AND SHOULD BE TAUGHT AS A PROFESSION."

And now, for the first time, you can profit by Edison's advice. You can actually learn invention as a profession—exactly as other people are learning electricity, automobile mechanics, law, medicine, as a profession. The Bureau of Inventive Science offers you the first course in practical invention ever devised, it has written down the easy-to-learn principles of Inventive Science so everybody could read them and learn to use them. You want the ability to invent—NOW. All you need, to become successful is this easy, fascinating training which will develop your ability so it will be worth real money.

Learn Invention by Actual Practice at Home

Hitherto inventors had to work out the principles of invention alone. But at what a terrific price in long years of discouragement, lost time, wasted money! Now you can quickly learn, in your spare time at home, the secrets of invention which brought wealth and fame to Edison, Marconi and other great inventors.

Today fifteen famous inventors tell you WHAT TO INVENT and HOW TO IN-



Little inventions like these have brought fortunes to their inventors



Raymond P. Lister, who with fourteen other famous inventors now makes it easy for you to learn how to invent in your spare time at home.

VENT. They tell you the secrets of invention which every successful inventor knows. They explain how to originate ideas, how to develop and perfect them, how to get patents. But they

tell you even more: Thousands of inexperienced inventors have been defrauded of their rewards because they did not know how to protect their patent rights. This great course tells you everything you want to know—how to sell your invention, how to get royalties—how to get the most money for your ideas.

New FREE Book

The most fascinating part of this great new course is that it teaches invention by actual practice, right in your own home. With each lesson you are sent some problem in invention—just like the one you worked out here. This fascinating exercise in solving actual problems in invention, sharpens your instinct to fix things. Better than anything else, it gives you an unforgettable, instinctive habit of thinking inventively, which is worth more than you realize. In fact the lessons and exercises are so simple, so easy to understand, so interesting, that they seem more like a pleasant game than like instruction which can make you a successful inventor.

A wonderful new book, just printed, tells you more about the Bureau of Inventive Science and its simple new course in invention. It explains in detail just how this course develops your ability to invent. It tells you how great inventors work, how to develop your ideas, how to get a patent, how to protect your invention, the best way to sell your invention, how to convert a simple little idea into big money, how to learn all the secrets of successful invention. It costs nothing, so send the coupon at once. This Bureau is not connected with patent attorneys or manufacturers. Its only purpose is to teach you the principles of practical invention used by every successful inventor. Write for the FREE BOOK now.

BUREAU OF INVENTIVE SCIENCE

Dept. 22

Wisner Building, Rochester, N. Y.

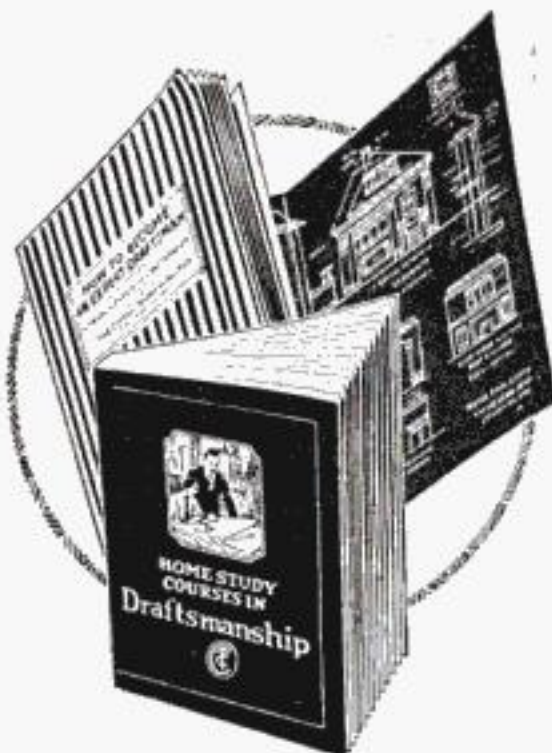
BUREAU OF INVENTIVE SCIENCE
Dept. 22, Wisner Bldg., Rochester, N. Y.

Please send me your free book, "The Science of Invention."

Name

Address

City Age

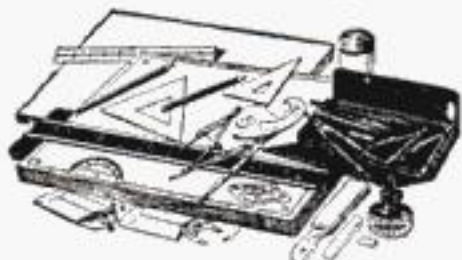


FREE TRIAL LESSON

Send the coupon and get this free Trial Lesson in Drafting prepared by the Chicago Tech. Experts. While other schools ask you to enroll and pay fees at once, Chicago Tech. sends this free lesson which will show you how well qualified you are to take up this paying profession. It also shows the Chicago Tech. method of training men by mail. Find out all about this before you pay a penny or decide about enrolling. Mail the coupon now.

DRAFTING

FREE Drawing Outfit



Students enrolled with Chicago Tech. for home study in Drafting receive this complete Drawing Outfit (retail price \$25) with no extra charge or they are given credit on fees if they have outfits. This is a regular full size outfit—same as used by practical draftsmen and engineers.

SEND COUPON

Mail the coupon and get the Free Trial Lesson—also catalogs and full information about the Chicago Tech. Method of teaching Drafting by mail. No cost to you—no promise or obligation. Fill out and send the coupon today.

CHICAGO TECHNICAL COLLEGE
Dept. 231, Chicago Tech. Bldg.,
118 East 26th St., Chicago, Ill.

Without cost or obligation on me please send instructive matter about opportunities in line I have marked with "X."

- ☐ Drafting. (The Big Salary Course.) No experience necessary. Free Lesson sent now.
- ☐ Building Trade Course. For men in the building lines.

Name.....
Address.....
Post Office.....
State.....

Get this expert training in Draftsmanship and put yourself in the big pay class. Don't stay in a small job when you can master Drafting in your spare time by the Chicago Tech. Method. There are not enough expert Draftsmen to fill the high salaried positions open now. You don't need special, preliminary education to master Drafting. The Chicago Tech. Method makes every step so easily understood that any intelligent man can master the subject.

Get this Training in Spare Time at Home Under Practical Men

Enrolled at Chicago Tech. you are instructed by practical engineers—not by mere theorists. These men have been "through the mill." They know just what problems you will have to solve in actual practice and they show you how to master them. No time wasted on unnecessary studies. You graduate early and can stand beside men of long experience. You get this training at a low cost and on easy terms. Here is the chance to satisfy your ambition to step quickly into a bigger income, to follow a profession, to win independence. Send the coupon now.

Big Jobs, Big Salaries for Chicago Tech. Men

Railroads, manufacturers, architects, contractors, electrical works—big industries everywhere—are always looking for expert Draftsmen. Chicago Tech. graduates step into the ranks of successful men because they have the practical knowledge which is wanted. E. A. McGurney was drawing \$35 a week. Trained the Chicago Tech. way and is making \$4500 a year. The same training increased Rex Cary's salary 300% and put O. L. Rosin in a successful business of his own. Hundreds of others report similar results. You have the same chance. What you need is training to make your services worth more than you can get for them without specialized knowledge. Chicago Tech. offers you this training by mail at a price you can easily afford to pay.

To Employers:
Chicago Tech. men are practical. Write to us when you need Draftsmen.

Chicago Technical College
Dept. 231, Chicago Tech. Bldg. 118 East 26th St., Chicago, Ill.

\$25.00 in PRIZES See top of page 6 in front of book for details



WANTED! Get \$1600 to \$2300 a Year
Men—Boys 18 or Over
Mail Coupon Immediately

Steady Work—No Layoffs—Paid Vacations
Travel—See the Country
Common Education Sufficient—
Send Coupon Today—SURE

Franklin Institute, Dept. E 277, Rochester, N. Y.
Sirs: Send me, without charge, (1) sample Railway Mail Clerk Examination questions; (2) tell me how to get a U. S. Government job; (3) send list of places at which examinations will be held; (4) send copy of illustrated book, "How to Get Government Jobs."

Name.....
Address.....

Money Making Opportunities

PHOTOGRAPHY AND SUPPLIES

HAVE you a camera? Write for free sample of our big magazine, showing how to make better pictures and earn money. American Photography, 117 Camera House, Boston, 17, Massachusetts.

FILMS Developed. Special Trial Offer. Any size Kodak film developed 5c, prints 3c each. Trial 6 x 10 Enlargement in handsome folder 40c. Overnight Service. Roanoke Photo Finishing Co., 212 Bell Ave., Roanoke, Virginia.

LEARN Photographic Journalism. Write Taytex, 28 School St., Boston, Mass.

CAMERA Hospital: Expert camera repairing a specialty. Send your broken camera, will write you cost. Turner, 1679 Ave. A., New York.

ESTABLISH yourself at home, as a photographic expert: make \$75 a week while learning; professional camera furnished free; write quick for full information. International Studios, Dept. 4329, 3601 Michigan Ave., Chicago.

FREE. Repeating our offer in the January issue to color a photograph free, we now add a full set of Peerless water colors—fifteen shades—with instructions, that you may prove our claims for these wonderful self-blending colors. Send us \$1.00 and we will mail them postpaid. Japanese Water Color Company, Peerless Building, Rochester, N. Y. Rochester Bank References.

SAMPLE enlargement, dime and negative (returned). Sample 6-exposure roll finished glossy, 25c silver. Brown Studio, Lake Elmo, Minnesota.

MODERN Professional Photography now taught successfully by mail. Students make big money while learning. New plan. Nothing like it. Unusual offer now open. Write to-day. International Studios, Dept. 1741, 3601 Michigan Ave., Chicago.

ARTISTS' MATERIALS

PAINTERS, Decorators, Printers, Artists. Book gives proportions for mixing 3000 colors, \$1.00. King, Box 1482, Indianapolis, Ind.

TELEGRAPHY

TELEGRAPHY in a Week—A new wonderfully simple system. Patent pending. \$1 postpaid. A. U. Medellin, Mesilla Park, New Mexico.

MOTION PICTURE BUSINESS

WRITE photoplays; \$50 each. Experience unnecessary. Details free to beginners. Producers' League, 312, St. Louis.

FOR SALE

ALL wool yarn for sale from manufacturer, 75c up per lb. Golf socks. Free samples. H. A. Bartlett, Harmony, Maine.

CHALK TALKS

LAUGH producing program, \$1.00. Circulars free. Cartoonist Balda, Oshkosh, Wisconsin.

OPTICAL GOODS

ARTIFICIAL eyes, \$3. Booklet free. Denver Optic, 508 Barclay, Denver, Colorado.

INDIAN GOODS

HUNTING BOWS, relics, minerals, geology, stamps, butterflies. Thousand Indian articles. Catalogue 10c. Indiancraft-S-Co, 466 Connecticut, Buffalo, N. Y.

FOR INVENTORS

INVENTORS' educator. 900 mechanical movements, 50 perpetual motions. How to procure and sell patents. Mechanical movements greatly assist inventors, suggest new ideas. Explain how to select an attorney and avoid patent sharks. Price \$1.50. Postage free. Albert E. Dietrich, 681 Ouray Building, Washington, D. C.

INVENTORS—If you have a practical, useful invention to sell, write us today. American Patents Corporation, Barrister Building, Washington, D. C.

I SELL patents. Established in 1900. Charles A. Scott, 773P8, Garson Avenue, Rochester, New York.

TO sell your patent, write me. Experienced handling. Immediate action. Address Arthur S. Billings, Suite 401, Dekum Bldg., Portland, Oregon.

UNPATENTED ideas can be sold. I tell you how and help you make the sale. Particulars free. Write W. E. Greene, Jenifer Building, Washington, D. C.

TO SELL your patent, write me; experienced handling. Immediate action. Address Arthur S. Billings, Suite 401, Dekum Bldg., Portland, Ore.

PATENTS—Write for Guide Book, List of Patent Buyers and "Record of Invention Blank." Send model or sketch of your invention for our free opinion of its patentable nature. Victor J. Evans & Co., 156 Ninth, Washington, D. C.

INVENTIONS Commercialized. Patented or unpatented. Write Adam Fisher Mfg. Co., 183, St. Louis, Mo.

PATENT Application, including one sheet drawings, prepared for \$15. Further particulars. Art. M. Benner, Olympia, Washington.

INVENTIONS developed. Working drawings for models. Machine designing. H. Wettstein, 150 Nassau St., New York.

More Money Making Opportunities
on pages 6 to 27



I Guarantee to fit You for \$5000 ELECTRICAL JOBS or It Doesn't Cost You One Cent

As Chief Engineer of the famous S & H Electrical Works I know exactly what you need to make you a high-class, electrical expert, capable of earning from \$65 to \$200 a week. I will fit you at home, in a few weeks, for the big-money jobs. Experience unnecessary. S & H Employment Service free. Also unlimited advisory service—long after you have finished training for the high electrical jobs, and your own profitable business. S & H is backed by the famous Lincoln Institute of Technology.

FREE PROOF *That You Can
Step Into
These Electrical Jobs Quick
This Amazing New Way*

WHY take chances? You want to step quickly into the big-money field of electricity, where there are countless opportunities. Naturally you want only the latest approved method of home training—the method endorsed by leading electrical experts. The method that doesn't hesitate to guarantee its promise to you.

As chief engineer of the S & H Electrical works I studied years upon the problem of making it possible for ambitious men who like electrical work to get the big-pay jobs without technical school or college education. I knew that every day the tragic shortage of technical experts hampered electrical progress. At last I discovered and copyrighted this remarkable Shop Type training in electricity, the biggest advance in 20 years in teaching electricity.

No Experience Needed

And now any man of average intelligence can step into these big-pay jobs. In your own home you can have the practical, actual shop type training. That's the secret of the amazing success of S & H graduates—I discovered how to apply practical training with the theory of electricity so that even men who have never finished grade school are graduating into salaries they never dreamed they could command. My great satisfaction is that I made it possible for men to step quickly into high positions of electricity—made long years of apprenticeship and small-pay toil in this great field unnecessary.

I Ask Only Twenty Weeks

This training is so plain, so simple, that many of my students graduate and enter the profession in only 20 weeks' time. And yet so thorough

S. V. Smith

S & H ELECTRICAL WORKS

Affiliated with Lincoln Institute of Technology

1422 W. Monroe St. Dept. B-16 Chicago, Ill.

that S & H graduates are in constant demand because they are trained in every branch of electricity. No wonder electrical experts have hailed this common-sense, practical, result-proving training as a boon to the electrical profession—so sadly in need of well-trained men.

A Legal Binding Guarantee

You can't afford to miss this chance to forsake small-pay work and start upon a career of certain big money. Remember, you have the absolute guarantee of the S & H Electrical Works and the Lincoln Institute of Technology back of this training. Your diploma will be from the Lincoln Tech. If when you have finished the course you are not satisfied, every cent will be refunded. No questions asked. We can afford to make this guarantee because I know that what I have done for others I can do for you. You will find that this new method of training far surpasses any other you have ever heard about. It makes you a real electrical expert, with the Lincoln Institute of Technology back of you.

Electrical Outfit Free

So that you can begin to earn while you are training—many of my students make far more than the cost of training after the first few lessons—you are entitled to my special offer of a complete outfit of electrical apparatus, instruments and appliances, **FREE, IF YOU MAIL COUPON AT ONCE.** Thus right at the start you have equipment for actual shop type training without a cent of cost. Here for the first time you have this remarkable offer, plus the privileges of the famous S & H Employment Service and Unlimited Advisory Service. And even that isn't all—I have still another amazing offer—Mail coupon today and I'll tell you about it. Don't delay.

FREE



Wanted

Supervising Engineers

Supervising Engineers for large power plants and systems always are in demand and hold positions of influence and big pay. I fit you for these jobs.

Superintendents

You can be quickly equipped to accept big positions as superintendents of municipal systems—every city, even towns and villages, have plants that need men constantly.

Foremen

One-half of all the business in the United States is electrical—many battery stations and electrical plants choose the S & H Shop type trained man for foreman and superintending positions.

Business of Your Own

And a business of your own—scores of my graduates have established themselves in business without capital—Unholz and Farina were common laborers when they wrote to me, now they head the prosperous U & F Electrical Company, Chicago. No profession in the world offers so many opportunities for a paying business of your own.

Chief Engineer Smith,
S & H Electrical Works,
1422 W. Monroe St., Dept. B-16,
Chicago, U.S.A.

Please send me full particulars of your training in practical electricity and details of your remarkable free offer to those who enroll now. I understand this is free and does not obligate me in any way.

Name.....

Address.....

City.....State.....

Don't Be A Wall Flower!

See How Easily You Can
Become a Good Dancer
—This New Way!

Arthur Murray has perfected a method through which you can learn to dance, in the privacy of your own home, any of the latest steps in a few minutes—and all of the latest dances in a short time. Instructions are so simple that even a child can quickly master them without assistance, and an entire family can learn from the one set of instructions. In one evening you can master the steps of any single dance. Partner or music are unnecessary. After learning you can dance with the most perfect dancer and not make a single mistake.

5 Dancing Lessons Free

About 5,000 people a month are learning to become perfect dancers through Arthur Murray's methods, and so sure is he that you will feel delighted with his amazingly simple methods of teaching that he has consented, for a limited time only, to send FIVE FREE LESSONS to all who sign and return the coupon.

These five free lessons are yours to keep—you need not return them. They are merely to prove that you can learn to dance without music or partner in your own home.

Write for the five lessons to-day—they are free. Just enclose 10c (stamps or coin) to pay cost of postage, printing, etc., and the free lessons will be promptly mailed to you. These



Posed by
Ann Forrest
famous
movie
star, and
Arthur
Murray,
the world's
foremost
dancing
instructor.

five free lessons are (1) The Secret of Leading; (2) How to Follow Successfully; (3) How to Gain Confidence; (4) A Fascinating Fox Trot Step; (5) A Lesson in Waltzing. Don't hesitate. You do not place yourself under any obligation by sending for the free lessons. Write today, Arthur Murray, Studio 7, 801 Madison Ave., N. Y. C.

Arthur Murray, Studio 7,
801 Madison Ave., New York City.

To prove that I can learn to dance at home in one evening you may send the FIVE FREE LESSONS. I enclose 10c (stamps or coin) to pay for the postage, printing, etc.

Address.....

Name.....

City..... State.....

Also at 150 Southampton Row, London, England.

Money Making Opportunities

PATENT ATTORNEYS

PATENTS—Before disclosing an invention the inventor should write for our blank form "Record of Invention." This should be signed, witnessed and returned to us together with model or sketch and description of the invention and we will give our opinion as to its patentable nature free. Our Three Books mailed free to inventors. Our Illustrated Guide Book, "How to Obtain a Patent," contains full instructions regarding patents. "List of Patent Buyers" sent free, contains unsolicited letters from manufacturers and others who are constantly writing us regarding the purchase or leasing of meritorious patents. Victor J. Evans & Co., 937 Ninth, Washington, D. C.

LUCKY Patent-Sense. "The Book the inventor keeps." Free. See page 136.

PATENTS PROCURED: trade marks registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Bldg., Washington, D. C., or 2276-Z Woolworth Bldg., New York.

INVENTORS' Guide free on request; gives valuable information and advice for all who have original ideas or improvements. Frank Lederman, Registered Attorney and Engineer, 15-8 Park Row, New York.

MILLIONS spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc., American Industries, Inc., 501 Kresge Bldg., Washington, D. C.

PATENTS. My own attention to your business. Twenty years' experience. Reasonable charges. Booklet on request. C. E. Trainor, 808 H Northwest, Washington, D. C.

"INVENTOR'S ADVISER" the valuable Patent book with 139 mechanical movements and illustrations, sent free upon request.—M. S. Labiner Patent Attorney, 3 Park Row, New York.

PATENTS, trade marks, copyrights. Prompt, personal reliable service. Over 30 years' active practice. Write for terms. Book free. Address E. G. Siggers, Box 1, N. U. Building, Washington, D. C.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising Popular Science Monthly, 225 West 39th Street, New York.

PATENTS—My fees in installments. Advice book free. Frank Fuller, Washington, D. C.

H. F. Lowenstein, registered patent attorney, Technical expert. 817 McLaughlin Building, Washington, D. C.

INVENTORS—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine, 232 Ouray Bldg., Washington, D. C.

HERBERT JENNER, patent attorney and mechanical expert, 606 F Street, Washington, D. C. I report if patent obtainable and exact cost. Send for circular.

THE PATENTOME is free. A liberal education in patents. Anderson & Son, attorneys, established 1865 636 F St., N. W., Washington, D. C.

MONROE MILLER, Ouray Bldg., Washington, D. C. Patent Attorney; Mechanical, Electrical Expert. Free Blue Book gives candid advice.

PATENTS. Booklets free. Highest references. Best results. Promptness assured. Watson E. Coleman, Patent Lawyer, 644 G Street, Washington, D. C.

COOPERATIVE plan for commercializing your inventions before patenting. Booklet free. Ralph Burch, Patent Lawyer, Jenifer Building, Washington.

AGENTS AND SALESMEN WANTED

BIG Money in spare time for one man in each locality making embossed show cards and price tickets for stores and others. Easy, quick work. No training needed. New embossing machine does it all. 400% profit. Signs sell on sight. T. W. Cushing of Chicago sold \$76 first call. S. D. Downes averaged \$15 a day for 6 months. Many sell \$5 to \$20 daily. No speculation. Before you invest a penny we send you free sample cards to show merchants and convince yourself they sell at sight. Write today. Praemafix Corporation of America, Dept. 400, Geneva, New York.

AGENTS—Best seller; Jem Rubber Repair for tires and tubes; supersedes vulcanization at a saving of over 800 per cent; put it on cold, it vulcanizes itself in two minutes, and is guaranteed to last the life of the tire or tube; sells to every auto owner and accessory dealer. For particulars how to make big money and free sample, address Amazon Rubber Co., 504 Amazon Building Philadelphia, Pennsylvania.

GET our plan for monogramming automobiles trucks, hand luggage and all similar articles by transfer method; experience unnecessary; exceptional profits. Motorists' Accessories Company, Mansfield, Ohio.

ONLY one sale a day means \$200 per month! Five sales \$1,000 per month. Marvelous new adding machine. Retail \$15.00. Work equals \$350 machine. Adds, subtracts, multiplies, divides automatically. Speedy, accurate, durable, handsome. Five year guarantee. Offices, stores, factories, garages buy one to dozen. A fortune for live agents. Write quick for protected territory and free trial offer. Lightning Calculator Co., Dept. P, Grand Rapids, Michigan.

\$10 DAILY silvering mirrors, plating and refinishing lamps, reflectors, autos, beds, chandeliers by new method. Outfits furnished. Write Gummetal Co., Ave. F, Decatur, Illinois.

MAKE \$25 to \$50 week representing Clows' Famous Philadelphia Hosiery, direct from mill—for men, women, children. Every pair guaranteed. Prices that win. Free book "How to Start" tells the story. George Clows Company, Desk 24, Philadelphia, Pennsylvania.

EVERYBODY uses extracts. Sell Duo Double strength Extracts. Complete line household necessities. Big repeaters. Write today. Duo Co., Dept. E66, Attica, N. Y.

More Money Making Opportunities
on pages 6 to 27

Earn Big Money
Learn the
Automobile
Business

PUT YOUR NAME HERE

Think of the repair work on fourteen million cars! Engines, electrical systems, batteries, tires, etc. There are not nearly enough trained men to do this work. Our graduates all over the world are successful. Age, education, or experience make no difference. You can be successful too if you will get M. S. A. S. practical training now.

Unlimited Opportunities for Trained Men
Study autos, trucks, engines, auto electricity, tractors, garage management, business methods, selling. Best equipment, expert instructors, a thorough complete course that slights nothing. Time to learn everything right. Here in Detroit, the Auto Center, you have wonderful advantages. Visit the great plants. Get factory endorsed training. Be successful! Write today for 100-page catalog describing school, Detroit, opportunities. Address A. G. Zeller, President. In writing, say whether you want to start your training at home or at our school in Detroit.

MICHIGAN STATE AUTOMOBILE SCHOOL
582 Auto Bldg. DETROIT, MICHIGAN

MASTER ELECTRICITY AT HOME

Send for Free Book. A straight-from-the-shoulder talk about your future. No misleading promises to insult your intelligence as "Earn \$10,000 a year" or "Become an Electrical Expert in a few months." Let me help you better yourself as I have helped thousands. Instructions easily understood.

FREE BUY SUCCESS WITH BURGESS TRAINING

Our close connection with International Association of Electrical Engineers gives you unusual chances. Experts everywhere endorse this course. All branches of electricity covered. FREE—Slide Rule and Course in Slide Rule Reading if you ACT NOW. Write TODAY for FREE Book, New Radio Course Now Ready. BURGESS ELECTRICAL SCHOOL

Yorke Burgess, Superintendent
Dept. 2, 746 E. 42nd St., CHICAGO, ILL.
Canadian Branch, 301 Crawford St., Toronto

A FILE **Stop Forgetting** **NOT A PILE**

Make Your Mind an Index from which you select facts, figures, names, faces. Develop concentration, self control; overcome bashfulness, forgetfulness. Write today for FREE memory and concentration test and illustrated booklet, "How to Remember."

Prof. HENRY DICKSON
Dept. 929 Evanston, Ill.

LEARN CARTOONING

Successful cartoonists earn big salaries. Many of the most popular cartoonists of to-day learned to draw in their spare time, at home, through the Landon Course of Cartooning and now earn \$75 to \$200 or more a week.



The Landon Picture Chart Method of teaching ORIGINAL drawing makes cartooning easy to learn. Hundreds of sketches like the above explain every step in creating ORIGINAL heads, figures, animals, etc. Send 6c. in stamps today for sample Landon Picture Chart and full explanation of this wonderful course, also long list of successful Landon students and information showing possibilities for you. Please state your age.

The Landon School, 751 National Bldg., Cleveland, Ohio

Four Successful Landon Students From One Village

Here is the record of four boys—all from Napanee, Ind., (2200 population) who, after taking the Landon Course, won national reputations.

Merrill Blosser is now nationally famous as creator of "Freckles and his Friends."

Henry Maust's work appears in Saturday Evening Post, Cosmopolitan, etc.

Francis Parks, following their advice, is now a cartoonist for the Omaha News.

Fred Neher is comic artist with the Universal Feature Co.

Easy as A-B-C!

You Can Play Any Instrument In a Few Months This Delightful New Easy Way!

Quickest because natural and pleasant. Grateful students say they learn in a *fraction* of the time old dull methods required. You play *direct from the notes*. And the cost is only a few cents a lesson!



LEARNING music is no longer a difficult task. If you can read the alphabet, you can now quickly learn to play your favorite instrument! That's actually true. A delightful new method has made it positively *easy* to become a capable performer within just a few months. And the cost is only a *fraction* of what people used to spend on the old, slow methods!

You don't need a private teacher, this new way. You study entirely at home, in the privacy of your own room, with no one to interrupt or embarrass you. Practice a lot or a little, as you like—according to your desire to get ahead—and enjoy every minute of it! For, strange as it may seem, the new method is agreeable as well as rapid.

You Needn't Know a Thing About Music to Take This Pleasant, Rapid Course

Even if you don't know one note from another now, you can easily grasp each clear, inspiring lesson of this surprising course. The things you must know are presented in such a concise, graphic way that even a child can understand them—yet not a minute is lost on unnecessary details. You instantly "get" the real meaning of musical notation, time, automatic finger control and harmony.

The lessons are delightfully human. You like them. You get ahead fast because everything you have to do is so reasonable and so pleasant. Even scale practice, the old bugaboo, is reduced to a minimum and made interesting! And almost before you realize your progress, you begin playing real tunes and melodies instead of just scales. Thus the course *interests* you all the time—*inspires* you—*encourages* you.

No Tricks or Stunts—You Learn from "Regular" Music

Yes, the new way teaches you to play from *notes*, just like the best musicians do. There are no trick "numbers," no "memory stunts." When you finish the U. S. School of Music course, you can pick

up any piece of regular printed music and *understand* it! Think what that means. You'll be able to *read* music, popular and classic, and *play it from the notes*. You'll acquire a life-long ability to please your friends, amuse yourself, and, if you like, make money (musicians are highly paid for their pleasant work).

The Surest Way to Be Popular and Have a Good Time

Do you sit "on the sidelines" at a party? Are you out of it because you can't play? Many, many people are! It's the musician who claims attention. If you play, you are *always* in demand. Many invitations come to you. Amateur orchestras offer you wonderful afternoons and evenings. And you meet the kind of people you have always wanted to know.

Never before have you had such a chance as this to become a musician—a really good player on your chosen instrument—without the deadly drudging and expense that were such drawbacks before. At last, you can start right in and get *somewhere* quickly, cheaply, thoroughly.



PROOF!

"I am making excellent progress on the 'cello'—and owe it all to your easy lessons."
George C. Lauer,
Belfast, Maine.

"I am now on my 12th lesson and can already play simple pieces. I knew nothing about music when I started."
Ethel Harnishfeger,
Fort Wayne, Ind.

"I have completed only 20 lessons and can play almost any kind of music I wish. My friends are astonished. I now play at church and Sunday School."
Turner B. Blake,
Harrisburg, Ill.

"I have been playing in the brass band for several months now. I learned to play from your easy lessons."
C. C. Mittlestadt,
Mora, Minn.

"Your lessons are the easiest way I know of learning to play. I am delighted with them."
Mary P. Williams,
Gest, Texas.

"I am well pleased with your lessons. I can now play most popular pieces."
Walter G. Riggle,
Phoenix, Arizona.

How You Learn Any Instrument So Easily This Way

The amazing success of students who take the U. S. School course is largely due to a newly perfected print-and-picture method that makes reading and playing music almost as simple as reading aloud from a book. You simply can't go wrong. First, you are *told* how a thing is done, then a picture *shows* you how, then you do it yourself and *hear* it. No private teacher could make it any clearer. The admirable lessons come to you by mail at regular intervals. They consist of complete printed instructions, diagrams, all the music you need, and music paper for writing out test exercises. And if anything comes up which is not *entirely* plain, you can write to your instructor and get a full, prompt, personal reply! Whether you take up piano, violin, cello, organ, saxophone, or any other instrument, you find that every single thing you need to know is explained in detail. And the explanation is always *practical*. Little theory—plenty of *accomplishment*. That's why students of this course get ahead

twice as fast—three times as fast—as those who study old-time, plodding methods! Read some of the letters on this page and see for yourself. They don't guarantee that *every one* can become a good player in three or four months; but they are written by people who didn't know any more about playing when they started the U. S. course than you do now. (Note that if you do know something about music now, the U. S. School of Music grades you and instructs you accordingly.)

Learn to Play by note

Piano	'Cello
Organ	Harmony and
Violin	Composition
Drums and	Sight Singing
Traps	Ukulele
Banjo	Guitar
Tenor	Hawaiian
Banjo	Steel Guitar
Mandolin	Harp
Clarinet	Cornet
Flute	Piccolo
Saxophone	Trombone
Voice and	Speech Culture
Automatic	Finger Control

Send Now for the Free Book that Makes You a Special Offer

The whole interesting story about the U. S. School course can not be told on this page. So a booklet has been printed—"Music Lessons in Your Own Home." You can have a copy absolutely free, for the trouble of filling out the coupon below—and in the booklet you will find a special temporary offer that makes the U. S. course available to you at half-price—if you act promptly. With it will be sent an Illustrated Folder which explains better than words how delightfully quick and easy the Print & Picture Method is. There is a good reason for this short-time reduction, as you will see on reading the booklet, but since the special offer reduces the lessons to a few cents each, we want only people who are seriously interested to take advantage of it! If you are really anxious to become a good player on your favorite instrument, mail the coupon now—today—while the special offer holds good!

Please write name and address plainly so that there will be no difficulty in booklet reaching you.

U. S. SCHOOL OF MUSIC

82 Brunswick Bldg. * New York City

U. S. SCHOOL OF MUSIC

82 Brunswick Bldg., New York City

Please send your free book, "Music Lessons in Your Own Home," Illustrated Folder, and particulars of your Special Offer. I am interested in the following course:

(Name of Instrument or Course)

Name.....
(Please Write Plainly)

Address.....

City.....State.....

Learn Electricity



In the Great Shops of
Coyne

Student Winding a Stator

Chicago The Electrical Center of the World

The whole world of electricity is open to the Coyne trained Electrical Expert. Come to Chicago—the Electrical Center of the World. Get your training at Coyne—the oldest, largest and best school of practical electricity in the country—the only school endorsed by the Electrical Industry. Coyne trains you in all branches of electricity. We do not offer a number of individual courses—we give you just one Complete course so that you will be an *Electrical Expert* capable of commanding big pay. Let ordinary electricians do the small jobs. You can become an *Expert* and get the big money in any branch of electricity if you seize this chance to come to Coyne. Opportunities for *Experts* are unlimited. Get started now!

Learn in 3½ Months

No books or useless theory. You are trained on the greatest outlay of electrical apparatus of any institution in the country. We give you FREE a complete course in Radio—the marvel of the age. Constructing, installing and operating. We also give you FREE a life Membership which enables you to stay as long as you want or come back for further training at any time without charge.

Earn \$250 to \$600 a Month!

You work on motors, generators, housewiring, autos, batteries, radio, switch-boards, power plants—everything to make you an expert ready to step right into a position paying from \$65 to \$150 a week. You get a complete practical training in Circuits, Housewiring, D. C., A. C., Armature and Stator Winding, Drafting, Auto, Truck and Tractor Electricity, Battery Building and Repairing, and Radio.

Earn While You Learn!

We help students to secure jobs to earn a good part of their living expenses while studying.

Send Coupon Now

Don't delay a minute—send that coupon right now for our big free catalog and full particulars of special offer. Act now!

COYNE
Electrical School

Endorsed by Electrical Industry

1300-1310 W. Harrison St., Dept. 93-62, Chicago

Coyne Electrical School, Dept. 93-62
1300-1310 W. Harrison St., Chicago

Dear Sir: Please send me free your big catalog and full particulars of your special offer.

Name.....

Address.....

Money Making Opportunities

AGENTS AND SALESMEN WANTED

BIG money and fast sales. Every owner buys gold initials for his auto. You charge \$1.50; make \$1.35. Ten orders daily easy. Write for particulars and free samples. American Monogram Co., Dept. 47, East Orange, New Jersey.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

POLMET polishing cloth cleans all metals; sells fast at 25c. Sample free. F. C. Gale, 15 Edinboro St., Boston.

WONDERFUL Invention—Eliminates all needles for phonographs. Saves time and annoyance. Preserves records. Lasts for years. 12,000,000 prospects. \$15.00 daily. Free sample to workers. Everplay, Desk 226, McClurg Bldg., Chicago.

50% PROFIT selling name cards, penknives, stationery, catalog. Wolf Labels, Station E, Philadelphia.

AGENTS Wanted—Something New—Fire Fighter sells easily. Makes a spectacular demonstration: car owners, homes, factories, stores practically buy on sight. Our men make \$10.00 to \$50.00 a day; exclusive territory. If you wish to establish a business of your own with unlimited possibilities for making big money, write us today. Fyr-Fyter Co., 191 Fyr-Fyter Bldg., Dayton, Ohio.

EARN \$10 daily silvering mirrors, plating and re-finishing metal ware, headlights, chandeliers, bedsteads. Outfits furnished. F. Dece Laboratories, 1133 Broadway, New York.

GET our free sample case toilet articles, perfumes and specialties. Wonderfully profitable. La Derma Co., Dept. F, St. Louis, Missouri.

AGENTS: Big profits. Best and cheapest window letters made. Easily applied. Dime brings five samples. Particulars free. Stalbrit Company, 1115 Second Avenue, New York.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

AGENTS make 500% profit handling auto monograms, new pictures, window letters, transfer flags, novelty signs. Catalog free. Hinton Co., Dept. 125, Star City, Indiana.

STAMPING names on emblem key checks. Sample 20c. Key check outfits, steel dies, key cases, etc. Service Sales Corporation, Shelby, Ohio.

AGENTS—Clever Invention! Inkspoon makes every pen a fountain pen. Fast office seller, big profit, demand increasing everywhere. Exclusive territory offered. Sample free. H. Marul Company, Tribune Building, New York.

AGENTS—\$15 a day—Easy, quick sales—Free auto—Big weekly bonus—\$1.50 premium free to every customer. Simply show our beautiful 7-piece, solid aluminum handle cutlery set. Appeals instantly. We deliver and collect. Pay daily. New Era Mfg. Co., 803 Madison Street, Dept. 411, Chicago.

RUMMAGE Sales make \$50.00 daily. We start you. Representatives wanted everywhere. "Wholesale Distributors," Dept. 34, 609 Division Street, Chicago.

INSTANT Weld—Repairs largest punctures without cement or heat. Lenn's profit one day \$56. Write quick. Free sample. Territory going fast. Tourist's Pride Mfg. Co., Desk R, Minneapolis, Minnesota.

FREE Sample "Rain Shield Wiper." Retail \$1.00—Costs (25c). Sold Clear and Rainy Days. No Cloth—No Paste—No Attachment. (1) Rub keeps Windshield Clear (48) Hours. Experience Unnecessary. Nullife Corporation, Hartford, Conn.

MAKE money silvering mirrors, all kinds plating, knives, spoons, auto headlights. Outfits furnished. Free Booklet. International Laboratories, Dept. 27, 311 Fifth Avenue, New York.

SALESMEN, can make \$5.00 a day selling our calendars, pencils, signs, advertising novelties, yardsticks, whistles, etc. Liberal terms. Sells entire year. Fine side line. Local and traveling agencies. Model Calendar Co., Dept. 309, South Bend, Indiana.

EASY, pleasant work for mechanics, shop men, clerks, during spare hours, will add many dollars to their salaries. Also want persons who can give full time. Big wages assured. Novelty Cutlery Company, 27 Bar Street, Canton, Ohio.

\$60-\$200 A WEEK. Genuine Gold Letters for store windows. Easily applied. Free samples. Liberal offer to general agents. Metallic Letter Co., 434A North Clark, Chicago.

\$742 LAST month for Beck, of Buffalo, introducing latest advertising plan; nothing else like it; every merchant wants it; easy sales; no deliveries; no collections; specialty salesmen write quick for offer. National Adv. Service, P. O. Box 51, LaGrange, Indiana.

AGENTS—Everywhere women's and children's guaranteed shoes direct to wearer. We deliver. A. P. Condon, Sales Manager, The Allen Shoe Co., 110 Summer Street, Boston, Massachusetts.

MEN, to sell regular \$1.00 and \$1.50 silk and knitted ties for 35c and 50c. Make \$15.00 daily. Write for particulars. American Cravat Exchange, 621 Broadway, New York.

AGENTS, both sexes, we manufacture and control new household article. Fast seller. Big profits. Exclusive territory. Write now. Connelly, 123 Liberty St., New York.

PATENTED Cigar Lighters with Glass Advertising Front. Also Electric Cigar Moisteners. Wonderful Sellers. No Competition. Big Steady Profits. Proof, Cuts, Sales Plan Free. Drake Mfg. Co., Dept. P., Milwaukee, Wis.

FORDS use kerosene and start instantly. Amazing invention. 200% profit. Territory going. Write Super, 1304-119 Fondulac, Milwaukee, Wis.

AGENTS Steady income. Large manufacturer of handkerchiefs and dress goods, etc., wishes representative in each locality. Factory to consumer. Big profits, honest goods. Credit given. Send for particulars. Freeport Mfg. Co., 24 Main Street, Brooklyn, N. Y.

WE start you without a dollar. Soaps, extracts, perfumes, toilet goods. Experience unnecessary. Carnation Co., Dept. 21, St. Louis.

More Money Making Opportunities
on pages 6 to 27

Do You Make these Mistakes in ENGLISH?

Free yourself of embarrassing mistakes in speaking and writing. Wonderful new invention automatically finds and corrects your mistakes; gives you a powerful mastery of language in only 15 minutes a day.

Many persons say, "Did you hear from him today?" They should say, "Have you heard from him today?" Some persons spell calendar "calender" or "calander." Still others say "between you and I" instead of "between you and me." It is astonishing how many persons use "who" for "whom" and mispronounce the simplest words. Few persons know whether to spell certain words with one or two "c's" or "m's" or "r's," or with "ie" or "ei." And very few persons use any but the most common words—colorless, flat, ordinary. Their speech and their letters are lifeless, monotonous, humdrum. Every time they talk or write they show themselves lacking in the essential points of English.

Every time you talk, every time you write, you show what you are. When you use the wrong word, when you mispronounce a word, when you punctuate incorrectly, when you use flat, ordinary words, you handicap yourself enormously. A striking command of English enables you to present your ideas clearly, forcefully, convincingly. If your language is incorrect it hurts you more than you will ever know, for people are too polite to tell you about your mistakes.

Wonderful New Invention

For many years Mr. Cody has studied the problem of creating instinctive habits of using good English. After countless experiments he finally invented a simple method by which you can acquire a better command of the English language in only 15 minutes a day. Now you can stop making the mistakes which have been hurting you. Mr. Cody's students have secured more improvement in five weeks than had previously been obtained by other pupils in two years!

Learn by Habit—Not by Rules

Under old methods rules are memorized, but correct habits are not formed. Finally the rules themselves are forgotten. The new Sherwin Cody method provides for the formation of correct habits by constantly calling attention only to the mistakes you yourself make—and then showing you the right way, without asking you to memorize any rules.

One of the wonderful things about Mr. Cody's course is the speed with which these habit-forming practice drills can be carried out. You can write the answers to fifty questions in 15 minutes and correct your work in 5 minutes more. The drudgery and work of copying have been ended by Mr. Cody. You concentrate always on your own mistakes until it becomes "second nature" to speak and write correctly.

FREE—Book on English and 15-Minute Test

A command of polished and effective language denotes education and shows your culture. It wins friends and favorably impresses those with whom you come in contact. In business and in social life correct English gives you added advantages and better opportunities, while poor English handicaps you more than you will ever realize. And now, in only 15 minutes a day—in your own home—you can actually see yourself improve by using the 100% self-correcting method.

Mr. Cody has prepared a simple 15-minute test with correct answers, which you can take in your own home so you can tell at once just where you stand. If you are efficient in English it will give you greater confidence; if you are deficient you surely want to know it. Write today for this test—it is free. We will also gladly mail you our new free book, "How to Speak and Write Masterly English." Merely mail the coupon or a postal card.

SHERWIN CODY SCHOOL of ENGLISH
182 Searle Building, Rochester, New York

SHERWIN CODY SCHOOL OF ENGLISH,
182 Searle Building, Rochester, N. Y.

Please send me your Free Book "How to Speak and Write Masterly English," and also the 15-minute Test.

Name.....

Address.....

City..... State.....

MEN WANTED!

I am teaching trades to men who want to get out of white collars and into overalls. Who want to quit being wage slaves whose job a strike or bad business or employer's whim can terminate without warning. Who want a chance to be independent, make real money and own their own business.

I refer you to sixty thousand men who found the way to success by sending for my catalog.

Earn \$50 a Week and Up!

If you are looking for work at \$50 a week and up, if you would like to get into something sure and solid that will give you success and independence, and can put in a few weeks this winter in TRAINING, write me today.

With over TWELVE MILLION automobiles running the demand for mechanics, demonstrators, chauffeurs, truck drivers, garage men, etc., is greater than ever before. Countless opportunities in cities and towns and even remote places. I estimate there are 20,000 Sweeney trained men owning their own garage or business.

FREE Catalog and Special Offer

Get my FREE 64-page catalog. It shows hundreds of actual photographs of men at work in my magnificent new school. Tells all about wages, profits, opportunities in auto and tractor business. Explains step by step how you learn. Interesting letters from graduates telling how they made good. Shows how men come from all over the world to this big school. Makes you want to join the crowd. Tells everything you want to know. I will gladly send you a copy, beautifully illustrated. I'll tell you how to get into business for yourself. No colored students accepted.

**Send This
Now** 

E. J. SWEENEY, President

LEARN A TRADE-
Sweeney
AUTOMOTIVE & ELECTRICAL SCHOOL
401 SWEENEY BLDG. KANSAS CITY, MO.



The white-collar worker contemplating a shift into a manual trade will find, with a little investigation, that the trades themselves are shifting. Yesterday he would have tackled something like carpentering, bricklaying, plastering, painting or typesetting. Today he finds a demand for men who understand automobiles, electricity, oxy-acetylene welding, and other crafts of comparatively recent development. Ten or fifteen years ago many of them did not exist. They have come into existence with the growth of internal-combustion power and the changed character of building.

—Saturday Evening Post
"The White Collar Shifts Into Overalls"

SWEENEY System of Practical Instruction

is the ONLY way to learn if you want to save time and money and be properly trained. You get this at the famous trade school, the MILLION DOLLAR SWEENEY SCHOOL and you get it nowhere else. I have helped 60,000 men to success. The way to learn is easy. You don't need any experience, age makes no difference. I teach with tools, not books. You learn by actually doing the work. I am making a *Special Thirty Day Offer*. That is why you should not delay. The first step is to send for my big Free Catalog.

EMORY J. SWEENEY, President

Dept. 401, Sweeney Building, Kansas City, Mo.

Send me free, without any obligation on my part, your 64-page catalog and Special Offer.

NAME

GIVE AGE

P. O.

STATE



**Would you like to earn
\$5,000
or more a year? Be an
AUTO EXPERT!**

You may
have
your
choice
of
these
jobs

Turn Your Idle Hours Into Golden Dollars

You want big money—a real job. My training fits you to get both. You don't have to leave home; you don't have to give up your present job; you don't have to risk a single dollar. My system of home training will fit you for a great money-making position in a few short months. All you need to become a master automotive expert is ability to read and write—and ambition to get ahead. I'll do the rest—in fact when you enroll with me it is just like having

Your Success Guaranteed

I know the bigness of the field. I know what every man has to know to win. I know how to point out the way to success—and big money. 14,000,000 passenger cars need attention, 2,000,000 trucks demand service. Farmers insist on experts for their tractor repairs. Aviation engineers make enormous salaries and the industry is just starting. There are wonderful positions open in every phase of automotive work—thousands of them—waiting to be filled. You can have your choice if you "know how."



Automotive Expert



Automotive Electrician



Salesman, Demonstrator



Manager and Owner

LEARN AT HOME THE C.A.I. JOB-WAY

Auto Repairing Automotive Electricity Vulcanizing Welding • Battery

Give me an hour a day and I'll qualify you to pull down a real income. My original C. A. I. Job-Way System of training is the only practical way to learn automotive work. You learn to handle every job just as the country's biggest engineers would do it. Anyone can understand my lessons. They're simple, direct, complete. Every lesson makes you expert on some particular job. Experts get the big pay. I can't begin to tell you all of the C. A. I. advantages here. Write today for

This Great Book FREE

It tells all about the most gigantic industry in the world. It tells you how to become a big man in that industry. This book shows exactly what the "Job-Way" system is. Contains many automotive diagrams. Tells of the success which C. A. I. has brought to others. Don't send a penny. Use a postal card or mail the coupon below.

Don't wait, mail the Coupon Today

CHICAGO AUTOMOTIVE INSTITUTE

J. R. Bayston, M. S. A. E., Pres.

Dept. 501, 536 South Clark Street, Chicago, Illinois

THE \$5,000 COUPON

J. R. Bayston, M. S. A. E., Pres.,
Chicago Automotive Institute,
Dept. 501, 536 S. Clark St., Chicago, Ill.

Without a penny of expense or the slightest obligation, please send me Free Book about your rapid course in Automotive Master Mechanics, and Free Tool Kit offer. Explain your money-back guarantee. I want to see a Free Lesson, too.

Name.....

Address.....

MEN WANTED!

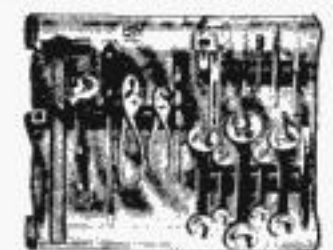
Thousands of big-pay jobs open right now, all over the U.S. Our Employment Service FREE to both students and graduates, reaches employers in every part of the Country. Look at this:

Master Mechanics	\$3,000-\$8,000
Electrical Experts	.. \$3,600 up
Garage Manager	.. 3,000 up
Battery Expert	.. 2,400 up
Expert Welder	.. 2,400 up
Salesman	.. 3,000 up
Tractor Engineer	.. 2,400 up

My graduates earn money fast enough to go into business. Own your own Garage, Battery Station, Ignition Service, Repair or Welding Plant



These Tools FREE!



This complete outfit of eighteen fine tools, worth at least \$15.00, doesn't cost you, as a student, one penny! Full size, everything you need to do the "Jobs."

Money Making Opportunities

AGENTS AND SALESMEN WANTED

AMAZING invention—almost human. The Little Draft-Man—a wonderful labor-saver, automatically opens furnace or boiler while owner sleeps. Pays for itself in fuel saved. Simple, efficient, can be installed by anyone in five minutes. 100% profit. Thousands being sold. \$25 daily easily made. Act quick. Address: Little Draft-Man Co., Dept. B, Grand Rapids, Michigan.

AGENTS make \$15 to \$20 day selling Match Strike Pins. Sample, 25c. W. T. Hodgkin, Campbellsville, Kentucky.

AGENTS—You can sell our Staples Oil Burner with a clear conscience. It's guaranteed for 5 years, and one burner sells another. You can average one sale per day in your spare time—This makes you \$41.40 per week. We back up our agents with local newspaper adv. If you are a plugger and want to make money write us now. Staples Mfg. Co., Box 288, Mt. Vernon, Ind.

YOU can make \$75.00 to \$100.00 a week selling our big line of 150 articles, used constantly in every home. Write us, we will send you our handsome \$15.00 Sample Case Outfit on trust. Federal Pure Food Co., Dept. 8, Chicago.

AUTO OWNERS! Get your tires Free! Be our Factory Agent! Big spare time money-maker! Sample tires furnished. No capital or experience needed. Write today. Armour Tire & Rubber Co., Territory, Desk 1002, Dayton, Ohio.

BIG profits in Card Signs for every business. Sample 10c. Signs, 819 St. Louis, New Orleans.

FLORISTS Plant Food promotes luxuriant growth, prevents disease. Price 25 cents. Agents profit large. DeMuth, Camden, Michigan.

OFFICE Necessity—Costs 25c; sells \$1.00. Many buy hundreds. Big repeater. Manufacturer, 3240 North 13th., Philadelphia.

A BUSINESS of your own. Make sparkling glass name plates, numbers, checker-boards, medallions, signs. Big illustrated book Free. E. Palmer, 311 Wooster, Ohio.

SELL necessities. Everybody needs and buys the "Business Guide." Bryant cleared \$800 in July. Send for sample. It's free. Nichols Company, Box 1B, Naperville, Illinois.

AGENTS—\$2.00 an hour. Magic Pomade keeps hair combed. I teach newest leads in selling. W. Blackburn, 3288 Beresford, Cincinnati, Ohio.

FORMULAR Processes, Trade-Secrets—Different, dependable, profitable. Catalog free. C. Thaxly Co., Washington, D. C.

AGENTS sell Wolverine Laundry Soap. Wonderful repeater and good profit maker. Free auto to hustlers. Wolverine Soap Co., Dept. B40, Grand Rapids, Mich.

WANTED County Distributors for World's Fastest Selling Automobile Accessory. Write D. Benross Co., 384 East 144th Street, New York.

AGENTS. Get my proposition. Brings dollars. Bedell Co., 789 S. 18th St., Newark, N. J.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

WE have openings for first class, live salesmen calling on the manufacturing metal trade and tool shops. This is a real opportunity which will greatly increase your earnings. For full particulars, call or write, Economy Products Co., 50 Spring St., Newark, N. J.

TAILORING Salesmen—Fastest selling line, suits, overcoats, made to measure—\$32.50—one price, all wool. Profits in advance. Biggest old reliable house. W. D. Smith & Co., Dept. 67, established 1895. Chicago.

WHY not sell us your spare time, \$2 an hour. \$19.70 daily easy for full time. Introducing New Style Guaranteed Hosiery. 57 styles, 17 colors. No capital or experience required. Just write orders, we deliver and collect. Your pay daily, also monthly bonus. Free auto offer besides. Elegant outfit furnished. All colors, grades including silks. Mac-O-Chee Mills Company, Room 1522, Cincinnati, Ohio.

\$100.00 MEN—We want men who want to make \$100.00 a week. For such men we have a \$100.00 a week proposition. The job is selling our Virginia Wool tailored-to-order suits and overcoats at \$31.75. The story is too big to tell here. But if you're the kind of man that can and must make \$100.00 a week, then take our word for it—we've got the proposition for you. Write for the proof at once. Address Dept. 761, Goodwear Chicago, Inc., 844 W. Adams St., Chicago.

SALESMEN: If you think in terms of \$6000 for next year, write now. Strong line for retail stores. Nationally advertised; established concern. Liberal weekly advances to producer. George R. Williams, 1920 Euclid, Cleveland, Ohio, Dept. 201.

AGENTS wanted full or part time to sell on liberal commission new Thermostatic Automatic Carburetor control attachment for Ford cars. Increases mileage 100%. No holes to drill. Attached in 2 minutes. Does automatically exactly what Ford Manual instructs driver do by hand. Cadillac now using Thermostatic Carburetor Control under Blawie license. Write at once. A. C. Blawie & Co., Dept. 20, 602 W. Lake St., Chicago.

START and operate your own business. Our System proprietary specialty business offers wonderful opportunity to make \$100 to \$500 weekly. Openings everywhere. Either men or women. We furnish everything and show you how. Big explanatory book, "The Open Door to Fortune" Free. Write for it now. Nat'l Scientific Labs., 224 Monroe, Richmond, Virginia.

EVERYBODY needs food. Our plan gives customer better quality and lower prices. Representatives wanted. \$100 a week and free automobile. Write quick. American Products Co., 1800 American Bldg., Cincinnati, Ohio.

MAKE \$17 day—Finest extracts, food products, toilet preparations, household necessities. Credit; sample case free. Write for amazing offer. Perkins Products, B-26, Hastings, Nebr.

MAKE \$31.00 Profit—Cost you \$1.50 Complete Gold Monogram Outfit. Transferred instantly on automobiles, trunks, bags, windows. Experience unnecessary. "Free Samples." Nullite Monogram, Hartford, Conn.

MEN, Women: business of own, in room of Home. Gold mine for Spare Time. Enclose Stamp. Home Expert, Valdosta, Ga.

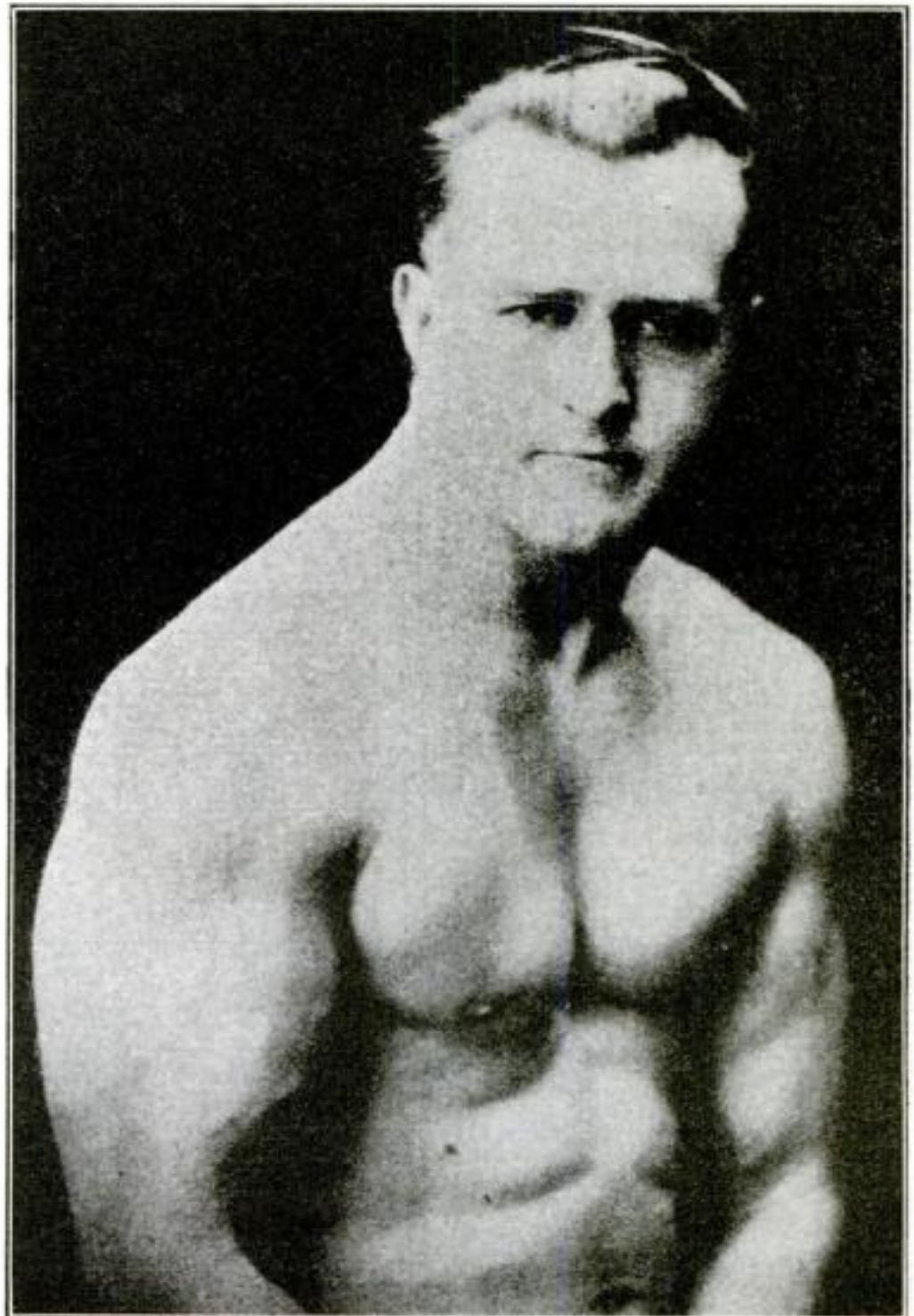
More Money Making Opportunities
on pages 6 to 27

Are You Ready for the Ash-Can?

DO you realize what it means to neglect your body? Do you know that you will clog up with waste matter and deaden your life just as the ashes do in a furnace? Are you going to drag yourself through a life of misery and be ready for the undertaker when you should really be only starting to enjoy life? Come on and brace up. Take a good hold of yourself and shake those cobwebs out of your brain. Give me a chance at that weak backbone of yours and let me put a pair of man-sized arms into those narrow shoulders.

Pills Never Made Muscles

I am not a medical doctor. I don't claim to cure disease. Neither do I put any self-assumed title of Professor before my name. *I am a builder of muscle*—internal as well as external. I claim and can prove that by proper exercise you can even build muscle in and around your heart and every vital organ. The kind that shoots a thrill through your veins and reaches every crevice of your body. I add years to your life, and oh boy! what a kick you get out of every day you live. And talk about big, brawny arms and legs, or broad backs and husky chests—just take a look through this winter's copies of Physical Culture Magazine and see for yourself. You will see a few pictures of my pupils there—living examples of the Earle Liederman system—doctors, lawyers, business men, but every last one of them good enough to pose as a professional strong man. Some are in better shape than men who are now acting as instructors to others.



EARLE E. LIEDERMAN,
America's Leading Director of Physical Education

Pep Up

What are you going to do about it? Don't sit idle and wish for strength. That will never bring it. Come on and get busy. You must have it, and I'm going to give it to you. I don't promise it, I guarantee it. You don't take any chance with me, so come on and make me prove it.

Send for My New 64-Page Book

"MUSCULAR DEVELOPMENT"

It contains forty-three full-page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. All I ask is 10 cents to cover the cost of wrapping and mailing, and it is yours to keep. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send today—right now, before you turn this page.

EARLE E. LIEDERMAN

Dept. 1302

309 Broadway, New York City

EARLE E. LIEDERMAN,

Dept. 1302, 309 Broadway, New York City

Dear Sir:—I enclose herewith 10 cents for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name.....

Street.....

City..... State.....

Money Making Opportunities

AGENTS AND SALESMEN

NEWEST Invention! Improved Pocket Calculating Machine. Does work of expensive machine. \$15.00. Agents: Big Profits! Schultheis, 1055-C Bergen Street, Brooklyn, N. Y.

SALESMEN can make \$5.00 a day selling Income Tax Records. Indispensable to merchants. Also Cash Books, Remittance Books and Petit Ledgers. Fine side lines; big profits, easy sellers. Pershing & Co., Dept. D, South Bend, Ind.

TWO-IN-ONE-LINE something new for Tailoring or Raincoat agents. Great for men who have been waiting to break into this profitable business. Union made-to-measure suits or overcoats at \$23.50. Raincoats \$3.95. A money maker from start to finish. Big repeater. Satisfied customers guaranteed. Real sales help. Offer will soon be withdrawn. Agency equipments are limited. Get in line for one of our \$100.00 a week jobs. Elliott Bradley Inc., 1028 W. Van Buren, Dept. A24, Chicago.

AGENTS: New Portable Talking Machine. Does more than machines costing five times its price. Carry it with you anywhere. Built in just like a suitcase. Biggest seller ever put on the market. Low priced. Write for sample and territory. Perry-Ludlow Co., Class 1861, Dayton, Ohio.

SELL new Automobile Smoking Set. Latest Advertising Specialty. Fastens on dash. Place for matchbox, cigarettes and ashes. Newton Mfg. Co., Department A2, Newton, Iowa.

AGENTS: Travel by auto, distribute soap samples—\$8.75 a day full time, or we can pay you \$1.25 an hour spare time. Write today for free samples and big offer. Harley Co., Dept. 156, Dayton, Ohio.

MAKE \$120 Weekly in Spare Time—Sell what the public wants—long distance radio receiving sets. Two sales weekly pays \$120 profit. No big investment, no canvassing. Sharpe of Colorado made \$955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. Ozarka, 803 Washington Blvd., Chicago.

100 AGENTS to sell auto accessories, write for sample. Box 4, Elmira, N. Y.

SELL Auto Quickstart—a new sensation! Starts motor instantly in cold or foggy weather. Eight other rapid sellers. No investment. Big money easy. Write Jubilee Co., 34 S. C. Omaha, Nebr.

HERE they are, fifty fast sellers. Everybody needs and buys. Fifty Dollars weekly easily made. B. & G. Rubber Co., Dept. 505, Pittsburgh, Pa.

WE pay \$200 monthly salary, furnish car and expenses to introduce our guaranteed poultry and stock powders. Bigler Company, X371, Springfield, Illinois.

FORMULAS—Dependable manufacturing formulas with complete working directions. Charges reasonable. Write me. S. Viggins, Chemist, 135 Meadow St., Pittsburgh, Pa.

\$300 PROFIT Weekly, installing automatic advertising directories in hotels, etc. The 12 ads sell quickly. Automatic information of train schedules, road maps, etc. Flash illuminated on opaque glass. Get particulars. Territory. Yes! Sterling Service, Ocean View, Va. 136-R.

AGENTS: Bill Omels, just an ordinary fellow, made over \$5000.00 during 1923 selling our \$1.50 kitchen specialty. He is now a district manager. We are offering you the same proposition—an opportunity as big as you want to make it. You can do what Omels did. Write today, M. H. Tyler Mfg. Co., Dept. P-1, Muncie, Ind.

AGENTS—Don't answer this ad if you don't mean business. But if you're out to make money and want a fast-selling proposition, address The Horsey-Bassett Company, Dept. P8-1, Crisfield, Maryland.

WHERE to buy 12,000 articles Wholesale. Actually worth \$50. Enclose stamp. Wholesale Supply Co., Valdosta, Ga.

WANTED salesmen to sell folding portable wardrobe. Big money. Manufacturer, H. S. Altman, Elcho, Wis.

AGENTS, Don't Pass This Up. A-14 disc tempered steel knife sharpener that sells on a demonstration. Guaranteed ten years. Retail \$1.00. 100% profit. Sample \$1.00, free on first order. Write, A. C. Conaway, 410 Dodson Bldg., Champaign, Ill.

MAGIC Polishing Cloth—great seller—big profit. Get our proposition. Newton Co., 71 Main St., Newark, New York.

ABSOLUTELY free box Bassett's Native Herbs sent to introduce for Constipation, indigestion, headache, rheumatism. Big money selling all or part time. Established 1879. Bassett, Dept. J, Columbus, Ohio.

SALESMEN. Big profits selling Ford owners combined Gasoline Gauge and Filler. Fills tanks without lifting cushion. Gauge always in sight. Territory closing fast. Sample \$3.50 on 10 Day Money-Back Trial. Write today. A. J. Kirstin Co., 131 Kirstin Bldg., Escanaba, Mich.

BRING Home the Bacon—selling Stuart's Stain Remover. Removes ink, iron rust, grass and fruit stains. Write for free samples and terms today. C. H. Stuart & Co., 5968 B'way, Newark, New York.

MEN, to sell regular \$1.00 and \$1.50 silk and knitted ties for 35c and 50c. Make \$15.00 daily. Write for particulars. American Cravat Exchange, 621 Broadway, New York.

BUSINESS OPPORTUNITIES

EARN big money making signs and house numbers. New, easy method. No skill needed. Write today. F. O. Armstrong, 149 N. Essex Ave., Orange, New Jersey.

FREE plan—start mail order business. H. J. Teeple, Decatur, Indiana.

PATENTS procured. Trade marks registered—A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 44 Owen Building, Washington, D. C., or 2276-Z Woolworth Bldg., New York.

1NCH Display Advertisement 166 Magazines Thrice \$15. Year \$50. Wood's Popular Service, Atlantic City.

UNLIMITED possibilities, making metal toys at home. No experience required. Particulars free. New Specialty Co., 448 E. 79th St., New York.

More Money Making Opportunities
on pages 6 to 27



FREE

Actual Reports of Secret Service Operator 38

HERE is something money can't buy. More fascinating than detective stories. Confidential reports of a real operator—No. 38—to his Secret Service Bureau, headed by the most famous detective in America. Absolutely free. No cost. No obligations. Don't fail to send for them.

They may point the way to Big Money for you. See how the modern detective works. Read these inside stories of the solution of great mysteries. See what possibilities this most fascinating and eventful of all professions offers to you—and how you may fit yourself for it.

Be a Finger Print Expert

To command the highest fees, the Secret Service man must also be a Finger Print Expert. These reports show why. This profession may be easily learned at home, in your spare time. Wonderful opportunity in this **UNCROWDED, PROFIT-ABLE** field.

Make \$5,000 to \$10,000 a Year

The unfulfilled demand for trained Finger Print men is increasing daily. Opportunity is waiting for you. No time to lose. Send today for these Reports, also our big Free book on Finger Prints. Gives all particulars and success stories of our graduates! Brilliant future ahead if you act now.

Special Offer Limited Time

Everyone getting these Free Reports will also receive my Special Offer of a Professional Finger Print Outfit, absolutely **FREE**. Made for a limited time only. Send coupon today—sure. Reports, Finger Print Book, and special outfit offer, all Free and Prepaid. Don't delay and perhaps forget. Do this right now.



← **Also
FREE**

Send the coupon

**UNIVERSITY OF
APPLIED SCIENCE**

1920 Sunnyside Ave., Dept. 13-62, Chicago, Ill.

T. G. COOKE, Pres. University of Applied Science
1920 Sunnyside Ave., Dept. 13-62, Chicago, Ill.

Dear Mr. Cooke: Please send me **FREE** and prepaid, Reports of Operator 38, your new illustrated book on Crime and Crime Detection and your Special Outfit Offer. It is fully understood I assume no obligation.

Name _____ Age _____

Address _____

Town _____ State _____



600,000 men and women work for me now. I have splendid positions for thousands more—for YOU!

It's easier to get a job in the Civil Service than in any private concern. Thousands wanted for over six hundred different kinds of positions. Work for Uncle Sam in a job you can't lose. Pay from \$1600 to \$2600 to start. Steady work. Easy hours. Yearly raises, rapid promotion. No strikes, no hard times, no dull seasons, no lay offs.

FREE BOOK No experience necessary to get Government position. All you need is to pass examinations. Arthur R. Patterson, 8 years an Official Examiner, trains you so you surely pass—guarantees that you get position or your money back. Write for free book describing how you can become Railway Mail Clerk, Postmaster, Mail Carrier, Customs Inspector, or any one of hundreds of other positions open and how you can easily qualify. Write NOW.

PATTERSON CIVIL SERVICE SCHOOL,
Dept. 162, Winner Building, Rochester, N. Y.



LEARN BY DOING

Every phase of all
branches of

ELECTRICITY

taught by

Actual Practice

In America's foremost and oldest
institution for trade training

No Books Used

Individual Instruction.
Start Any Day

Write for **FREE 64-page catalog**

THE NEW YORK ELECTRICAL SCHOOL

40 West 17th St., New York City



MAKE MONEY AT HOME

You can make 15 to 50 Dollars a week at Home, in Your Spare Time. Easily learned by our New Simple Method. No Canvassing. Experience Unnecessary. We Teach You How. Guarantee you Steady Work and pay you cash no matter where you live. Write today for Free sample lesson and illustrated Booklet.

UNITED SHOW CARD STUDIOS, 807 Dixon Bldg., Detroit, Mich.

"STAMMERING Its Cause and Cure"

You can be quickly cured. Send 10 cents for 288 page cloth bound book on Stammering and Stuttering. It tells how I cured myself after Stammering and Stuttering for 20 years. **BENJAMIN N. BOGUE**, 7502 Bogue Building, 1147 N. Ill. St., Indianapolis.



More Money For You in RADIO

THE amazing expansion of Radio has opened up hundreds of wonderful new positions on land and sea. Big salaries, fascinating, easy work, short hours, and a wonderful future are offered to ambitious men who get into Radio now.

Take advantage of these wonderful opportunities to step into a big paying position in this great new field. Radio offers you an opportunity to travel and see the world, with all expenses paid, and a fine salary besides. Or you can stay at home and work up to a position paying up to \$10,000 a year. One of our recent graduates secured a position one week after graduating, paying a salary of \$300 per month.

Easy to Learn Radio At Home

Hundreds of men are already earning handsome incomes in this wonder science. If you want to get into a profession where opportunities are unlimited make Radio your career—become a Certified Radio-trician.

Thousands of Certified Radio-tricians are wanted to design Radio sets; to make new Radio improvements; to manufacture Radio equipment and to install it; to maintain and operate great broadcasting stations and home Radio sets; to repair and sell Radio apparatus; to go into business for themselves; to operate aboard ship and at land stations.

You can easily and quickly qualify in your spare time at home, through the help of the National Radio Institute. Prominent Radio experts will help you. Four wonderful instruments are loaned to students, making the work thoroughly practical. The same plan that has already helped hundreds of our graduates to real success and real money in Radio is open to you.

Send for BIG BOOK

No other field today offers such great opportunities as Radio. Take your choice of the many wonderful openings everywhere. Prepare now to step into the most interesting and best paid profession today. Read about the opportunities open now—the different kinds of work—the salaries paid. Write today for the 44-page book that tells how America's first and biggest Radio school can teach you to become a Certified Radio-trician in your spare time. Mail the coupon or write a letter NOW.

National Radio Institute

Dept. 12AB
Washington, D. C.

National Radio Institute, Dept. 12AB
Washington, D. C.

Without obligation send me your book, "Rich Rewards in Radio," which tells all about the opportunities in Radio, how spare time study at home will qualify me quickly as a Certified Radio-trician so I can get one of these splendid positions, and how your Employment Service helps me to secure a big pay job.

Name Age
Street
City State

Note: Radio Firms Secure practical Radio experts among our graduates. Write us today.

HAWKINS ELECTRICAL GUIDES

3500 PAGES—4700 PICTURES—\$1 A VOLUME—\$1 A MONTH—10 VOLUMES

Know the facts in Electricity. They mean more money and better position for you. Hawkins Guides tell you all you need to know about Electricity. Every important electrical subject covered so you can understand it. Easy to study and apply. A complete, practical working course, in 10 volumes. Books are pocket size; flexible covers. Order a set today to look over.



**POCKET
SIZE**

**FLEXIBLE
COVERS**

*Easy to Read
and Understand*

LEARN ALL ABOUT THESE IMPORTANT POINTS

Magnetism — Induction — Experiments —
Dynamoes — Electric Machinery — Motors —
Armatures — Armature Windings — Installing of Dynamoes—Electric Instrument Testing—Practical Management of Dynamoes and Motors—Distribution Systems—Wiring—Wiring Diagrams—Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors — Transformers — Converters — Rectifiers — Al-

ternating Current Systems — Circuit Breakers — Measuring Instruments—Switchboards — Wiring — Power Stations — Installing — Telephone — Telegraph — Wireless — Bells — Lighting — Railways. Also many Modern Practical Applications of Electricity and Ready Reference Index of the ten numbers.

SHIPPED FREE NOTHING TO PAY TO THE POSTMAN

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send Coupon now—today—and get this great help library and see if it is not worth \$100.00 to you—you pay \$1.00 a month for ten months or return it.

Over 5000
readers have
O.K.'d
this set.

**USE FREE
COUPON
NOW**

THEO. AUDEL & CO., 72 Fifth Ave., New York City
Please submit me for free examination, HAWKINS ELECTRICAL GUIDE (Price \$1 a number). Ship at once prepaid, the 10 numbers. If satisfactory, I agree to send you \$1 within seven days and to further mail you \$1.00 each month until paid.

Name
Occupation
Employed by
Home Address
Reference
P.S.M. 2-24



\$100⁰⁰ a week for Drawing

COMMERCIAL art is a necessity to modern business and advertising. If you like to draw, you are indeed fortunate, for well trained artists are always at a premium. They readily earn \$75, \$100, \$150 a week, and even more. Many Federal students command \$50 a week or more after a short period of practical work.

Learn Quickly at Home in Your Spare Time

Develop your talent—learn the methods and secrets that make your drawings worth real money. Thousands of business firms pay millions of dollars annually for good advertising drawings and designs. No previous training or experience is needed to learn by the Federal Course, which clearly explains each step, and gives you individual personal criticisms on all your lessons.

Leading designers, artists, illustrating companies and hundreds of successful Federal Students have enthusiastically endorsed Federal Training. Among Federal Authors, whose help you get exclusively in the Federal Course, are many of the best known artists and designers in America, who have produced and sold hundreds of thousands of dollars' worth of commercial art.

Send Today for "YOUR FUTURE"

It is beautifully illustrated in colors, and tells every detail you need to know about the Federal Course. It shows work of Federal students, many of whom earn more than the course costs while studying. The Federal Course is aimed at practical results—and gets them. If you are in earnest about your future, send 6c in stamps today for this book, kindly stating your age and occupation.



COUPON

Federal School of Commercial Designing
1351 Federal Schools Bldg.,
Minneapolis, Minn.

Please send me "Your Future" for which I enclose 6c in stamps.

Name.....

Age..... Occupation.....
(Write your address plainly in the margin.)

Money Making Opportunities

BUSINESS OPPORTUNITIES

FREE Instructive Book. Start your own little Mail Order business. Home employment evenings. Also secure Agents to sell for you. We tell you how. Also furnish Beginner's Outfit circulars, samples, specialties. Book sent free. Pier, 552-A, 74 Cortland Street, New York.

ARTIFICIAL Marble, sanitary flooring instruction ornamental casting, concrete plaster, papier-mache decorations, garden furniture, statuary. Rubber moulds. Electrometallurgy, particulars and 200 illustrations free. Chris. Mahler, Huntington, N. Y.

\$3,000 to \$6,000 yearly. Want it? Others are making it. Send check or money order today for our invaluable books "How to Sell Real Estate," \$3.00—and "How to Conduct Real Estate and Insurance Business," \$1.50. Absolute satisfaction guaranteed. Free Catalogs. Realty Book Co., Dept. 100, Cleveland, Ohio.

PATENTS—Write for our Guide Books, List of Patent Buyers and "Record of Invention Blank" before disclosing inventions. Send model or sketch of your invention for our free opinion of its patentable nature. Terms Reasonable. Victor J. Evans & Co., 190 Ninth, Washington, D. C.

LEARN the collection business. Good income; quick results. Interesting booklet, "Skillful Collecting," free. National Collector's Association, Science Building, Newark, Ohio.

FOREIGN money at bargain prices. List free. Craig Dare, 440 65th St., Brooklyn, New York.

WE Start you in business, furnishing everything; men and women, \$80.00 to \$100.00 weekly operating our "New System Specialty Candy Factories" anywhere. Opportunity lifetime; booklet free. W. Hillyer Ragsdale, Drawer 19, East Orange, N. J.

PUBLISH your own magazine. Everything supplied. Sample and instructions; quarter. Lebeuf, Bangor, N. Y.

I HAVE over 100 stores paying \$5 monthly. You can do the same in your city. Month's practice qualifies. Midnight Alarm System, 2965 Algonquin, Detroit.

HOW to Raise \$500 to \$10,000 quickly. N. Home 1957 Warren, Chicago.

YOU can have a business profession of your own and earn big money in service fees. A new system of foot correction; readily learned by anyone at home in a few weeks. Easy terms for training, openings everywhere with all the trade you can attend to. No capital required or goods to buy, no agency or soliciting. Address Stephenson Laboratory, 15 Back Bay, Boston, Massachusetts.

USED correspondence courses sold, rented and exchanged. List free. (Courses bought.) Lee Mountain, Pisgah, Alabama.

STOP plodding! Be successful. Operate a tire repair shop. Make big profits in any locality. We teach you and furnish complete equipments, \$100 up. Book of Opportunity free. Haywood's, 1306 South Oakley Avenue, Chicago.

SMALL manufacturer wants partner with some capital to enlarge present output. This is A-1 proposition. can give good bank reference. Prefer party to take charge of office. Write for particulars. Federal Tool Co., Wenona, Illinois.

I EARN over \$50.00 weekly manufacturing small article at home evenings. You can too, \$15.00 starts you. 1000% profit, unlimited demand, experience unnecessary, no canvassing, free particulars tell how. Robinson, 2926 A, Inglewood, St., Los Angeles, Calif.

SCHEMER Magazine, Alliance, Ohio, prints big profit schemes; one subscriber making \$25,000 from three; another \$10,000 from one. Try your luck. Year, \$1; 3 months, 25c.

FREE Booklet describes four methods of making money. \$50 starts you. Dept. R, Paul Kaye, 149 Broadway, N. Y.

I MADE \$30 a week home. French breadmaking. 15 years' experience; free booklet tells. Ashbrook, E. 67, Marengo, Ohio.

THE Great Wheat Secret. Solves the Mystery of market swings. Long or short swings easily forecasted. Amazing profits available. Send for information today. Market Forecaster Co., Dept. 14, Topeka, Kans.

FREE Advice, How to be successful in real estate. Particulars, Macdonald Cooperative Realty. San Diego, Calif.

LEARN mail order business. New System raise money. Taytex, 28 School St., Boston.

GOLD Window Sign Letters manufactured at home. Unlimited profits and business opportunities. Complete instructions and patterns. No experience required. Particulars. Wulterding, 3161 Abbott Court, Chicago.

MAKE \$25.00—\$75.00 Weekly in Your Spare Time. Writing Show Cards for us at home. No canvassing. Simple instructions. No previous experience necessary. Write to-day for full particulars. National Studios, 6121 Dorchester Ave., Dept. 27-A, Chicago, Ill.

HELP WANTED

BE a detective. Excellent opportunity to earn big money, travel, thousands of dollars offered in rewards. Established 1909. Particulars free. Write to C. T. Ludwig, 424 Westover Bldg., Kansas City, Mo.

SILVERING Mirrors, French plate. Easily learned; immense profits. Plans free. Wear Mirror Works, Excelsior Springs, Mo.

OUR genuine gold window sign letters are an excellent money-making proposition for handy men. Slann Sign System, East Bethune Avenue, Detroit, Michigan.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports. Salaries, expense. American Foreign Detective Agency, 321, St. Louis.

WRITE photoplays; \$50 each. Experience unnecessary; details free to beginners. Producers' League, 312, St. Louis.

ALL men, women, boys, girls, 17 to 65, willing to accept Government Positions, \$117 - \$250, traveling or stationary, write Mr. Ozment, 295, St. Louis, Mo., immediately.

EARN \$10.00 to \$35.00 weekly mailing circulars at home. Outfit and instructions 25 cents. Jamorris, 2305 Gratz, Philadelphia, Pa.

WANTED—Representatives in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.

More Money Making Opportunities
on pages 6 to 27



Are You Earning Big \$100 a Week?

Would you like to be a star salesman? Men who have mastered salesmanship—who are really proficient—name their own salaries. \$5,000 to \$10,000 a year and better not uncommon. Big money and opportunities in business always open to men who can SELL. Success in selling field leads to highest executive positions. Demand enormous. Old theory about "born salesman" exploded. Any man of average intelligence can now learn to sell thru scientific coaching. Training, the secret. Write today for free book, "MODERN SALESMANSHIP." It tells how you can quickly get into the selling game and win your way to the big-pay jobs. Learn in spare hours at home principles and methods of ablest sales organizations in America. Successful salesmen report sales doubled and trebled thru scientific study of salesmanship under LaSalle Problem Method. Low tuition fee—easy terms. Write now for information.

LASALLE EXTENSION UNIVERSITY

The Largest Business Training Institution in the World
Dept. 283-SR Chicago, Illinois

Gentlemen: Send without obligation to me information regarding course indicated below:

☐ **Modern Salesmanship**
LaSalle is the largest business training institution in the world. It offers training for every important business need. If more interested in any of these courses, check here:

- | | |
|--|--|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Modern Business Correspondence and Practice |
| <input type="checkbox"/> Higher Accountancy | <input type="checkbox"/> Modern Foremanship and Production Methods |
| <input type="checkbox"/> Traffic Management—Foreign and Domestic | <input type="checkbox"/> Personnel and Employment Management |
| <input type="checkbox"/> Railway Station Management | <input type="checkbox"/> Expert Bookkeeping |
| <input type="checkbox"/> Law, Degree of LL. B. | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Commercial Law | <input type="checkbox"/> Commercial Spanish |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Effective Speaking |
| <input type="checkbox"/> Efficiency | <input type="checkbox"/> C. P. A. Coaching |
| <input type="checkbox"/> Banking and Finance | |

Name.....

Present Position.....

Address.....

Learn to Write

I Teach By Mail

I can make a good penman of you at your home during spare time, no matter where you live or how poorly you now write. My simplified system has shown thousands the way to good penmanship during the past twenty-five years—it CAN and WILL do the same for YOU—

"My beautifully illustrated 32-page Book"

"How to Become a Good Penman" FREE!!

It contains many beautiful specimens of penmanship showing what others have accomplished by the Tambllyn System, with testimonials and general information about our course—(Your name elegantly written on a card if you enclose stamp for postage). Ladies taught as successfully as men. **WRITE TODAY, address**

F. W. TAMBLYN
437 Ridge Bldg., Kansas City, Mo., U. S. A.

Radio Phone Receiving A practical book for everybody. Written in non-technical terms by nine specialists. 224 pages. Fully illustrated. Price \$1.50.
Popular Science Monthly, 225 W. 39th St., New York

Money Making Opportunities

HELP WANTED

GOVERNMENT positions. \$1400-\$2300 yearly. Many openings. Thirty-six page information booklet free. Chicago Civil Service College, B-70, Kesner Building, Chicago.

MAKE money in spare time mailing letters. Rare opportunity now. Men, send addressed envelope for special terms. Normandie H. 147 W 23d St., New York.

DETECTIVES earn big money. Excellent opportunity. Travel. Fascinating work. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, New York.

CLERKS for Government Postal and other good positions \$1400-\$2300 yearly. Experience unnecessary. Full particulars free by writing G. W. Robbins, Civil Service Expert, 424 Burchell Bldg., Washington, D. C.

U. S. Government wants Railway Mail Clerks. \$133 month. List positions free. Write immediately. Franklin Institute, Dept. F41, Rochester, N. Y.

YOUNG men wanted, to learn fine clean trade. Big salary and splendid opportunities, tools and instructions free. Write National Instrument Co., 4704 North Hamilton, Chicago, Dept. D.

\$50-\$200 WEEK. Genuine Gold Letters for store windows easily applied. Liberal offer to general agents. Metallic Letter Co., 431B N. Clark, Chicago.

RAILWAY Postal Clerks—Start \$133 month. Railroad pass; expenses paid; questions free. Columbus Institute, N-2, Columbus, Ohio.

SHORTHAND in 30 days; familiar characters used; simple, speedy. Dickinson, 331-P Altman Building, Kansas City, Mo. Teachers wanted.

WANTED—Railway Mail Clerks. \$1600. Experience or correspondence course unnecessary. Write, Mr. Selby, D69, Willow Hill, Ill.

MONEY silvering mirrors, replate autolights, radiators, chandeliers, stoves, silverware, brass beds, etc. Outfits. Methods free. Clarence Sprinkle, Dept. 95, Marion, Ind.

SALESMEN—We pay larger commission than any other Brush House in the country to men selling our line of Sanitary twisted wire brushes. Sanitary Wire Grip Brush Co., 15 Mercer St., New York.

FIREMEN, brakemen, baggagemen, sleeping-car, train porters (colored). \$140-\$200. Experience unnecessary. 838 Railway Bureau, E. St. Louis.

MOTION Picture Operators wanted. Short Course. Positions secured for all competent men. Box 38, Sioux Falls, So. Dakota.

MAKE \$2.00 an hour in your spare time taking subscriptions to "Popular Science." Write today for the agency in your town. Popular Science Monthly, 225 West 39th Street, New York, N. Y.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

STAMPS AND COINS

NYASSA Giraffes and packet of 52 different scarce stamps. Flume Triangle, large, \$1.00 U. S. Rev., millimetre scale, perforation gauge and ruler for only 9c. To introduce our Sudden Service approvals. Fennell Stamp Company, Dept. C., Fullerton Bldg., St. Louis, Mo.

158 GENUINE Foreign Stamps—Mexican War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., for only 10c. Finest approval sheets 50% to 60%. Agents wanted. Big 72-p. lists free. We buy stamps. Established 29 years. Hussman Stamp Company, Dept. 55, St. Louis, Missouri.

SEND references for best 60% approvals in America. Norman Schultz, Colorado Springs, Colorado.

STAMPS—50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S. 25c. 1,000 hinges, 10c. 1,000 mixed, 40c. List free. C. Stegman, 5949 Cote Brilliante, St. Louis, Missouri.

17 VARIETIES Bulgaria stamps, 20 cents. List of 7,000 low-priced stamps free. Chambers Stamp Company, 111C, Nassau Street, New York City.

CALIFORNIA gold \$ 1/4 size, 27c; \$ 1/2 size, 53c. White cent and catalogue, 10c. Norman Schultz, Colorado Springs, Colorado.

STAMPS free! 24 British Colonials to approval applicants. Nickles, 122 Florida, Washington, D. C.

OLD coins—Large Spring selling catalog of coins for sale, free. Catalog quoting prices paid for coins, 10c. William Hestlein, 101-B Tremont St., Boston, Mass.

2000 DIFFERENT Stamps, \$5.50, 1000, \$1.50, 500, 55c; 300, 27c. Michael, 5353 Calumet, Chicago.

FREE—14 Ukrainia to (50%) approval applicants only. Lampe, 423 West 42nd, New York.

100 DIFFERENT stamps free to popular approval applicants; postage 2c. Christensen, 124 Second Street, Milwaukee, Wis.

22 DIFFERENT Foreign Coins, postpaid 50c. Otto Oddehon, Independence, Missouri.

FREE—25 different U. S. stamps with 60% approvals to reliable parties; 75 different U. S. stamps 25c; C. Seidenberg, Merton, Wisconsin.

ALL different 1000 \$1.50, 700, \$1.00, 100 Hungary 25c. Fred Onken, 630 79th Street, Brooklyn.

ARGENTINE—20 different 15c. Browne, 90 Kemper St., Wollaston, Mass.

STAMPS, 100. All different 3 cents. Lists free. P. S. Quaker Stamp Co., Toledo, Ohio.

COINS, medals, paper money, antique firearms, daggers, stamps. Lists free. NAGY, 335 South 18th Street, Philadelphia.

MR. ADVERTISER: Ask to-day for a copy of the "Quick-Action Advertising Rate Folder." It contains some really important facts which will prove interesting and valuable to you. It also tells "How You Can Use Popular Science Monthly Profitably." You'd like to know, wouldn't you? Manager, Classified Advertising, Popular Science Monthly, 225 West 39th Street, New York.

More Money Making Opportunities
on pages 6 to 26

Your Copy of this great book

Electricity and its Opportunities for YOU

FREE

Send for it TODAY

You can Boss the Job

Mark These 9 Feature Points of A.E.E. Service

- 1 Life Membership in the Associated Electrical Engineers
- 2 Our exclusive and copyrighted method of training
- 3 Unlimited Placement Service throughout your career
- 4 Unlimited Consultation Service
- 5 A wonderful Laboratory and Experimental Outfit
- 6 A Complete Course in Automotive Electricity
- 7 A Complete Course in Radio
- 8 A Complete Course in Business for the Electrical Expert
- 9 A Legally Binding Guarantee of Satisfaction



This is the mark of the
Associated Electrical Engineers
Follow it to SUCCESS!

This handsome, profusely illustrated book will tell you of the astonishing growth of the great Electrical Industry, and of the thousands of big money jobs and opportunities waiting for trained men.

More important, it will tell you of the great Associated Electrical Engineers—chartered by the State of Illinois, as an institution for the advancement of every phase of Electrical Science. Not a mere school, but a great National Organization of Electrical Experts and Specialists, who have developed the MOST REMARKABLE SYSTEM ON EARTH for HOME TRAINING IN ELECTRICITY.

We Train You at Home

in your spare time, quickly and surely, by our EXCLUSIVE AND COPYRIGHTED METHOD to qualify to

Earn \$75 to \$200 a Week

as an Electrical Expert or in business for yourself—and

We Help You "Cash In"

through our Placement Department and our great FREE BUSINESS COURSE, which will show you how to get the big-money Electrical jobs and how to establish your own independent, profitable Electrical business.

Our Book Tells the Story

Our BIG 64-PAGE ILLUSTRATED BOOK will tell you fully about every one of the 9 remarkable features of Associated Electrical Engineers Service, and how they will be the stepping stones for you from futureless, low-pay jobs up into the limitless, big-money opportunities in Electricity.

You Have Education Enough

If you have the AMBITION to succeed and make big money as an Electrical Expert, we will guarantee the rest.

Mail the Coupon NOW

Get this remarkable book. It is FREE. You will incur no obligation in asking for it. We want every ambitious man in America to have one and receive this great message. Your copy is ready. Send for it TODAY.

ASSOCIATED ELECTRICAL ENGINEERS
Dept. 224, 537 South Dearborn Street, CHICAGO, ILL.

Here's Opportunity's Wide Open Door

Associated Electrical Engineers
Department 224

537 South Dearborn Street, Chicago, Ill.

Without obligation, send me your 64-page illustrated book on Electricity, together with full details of your remarkable plan of home training and membership in the A.E.E.

Name

Address

Associated Electrical Engineers
OF AMERICA

They Started Where You Are Today



Charles P. Steinmetz



Thomas Edison

Make Your Start Today

The new book "Be a Power In Electricity" shows you how such men as Tesla, Marconi, Bell, etc., won their laurels in Electricity. What they did you can do. This book is the first step. Write for your Free Copy today. No obligation. Use the coupon.

AMERICAN SCHOOL
Electrical Division
Chicago, U.S.A.



Nikola Tesla



Samuel Morse



Alexander G. Bell



Guglielmo Marconi

AMERICAN SCHOOL, Dept. E-275, Drexel Ave. & 58th St., Chicago

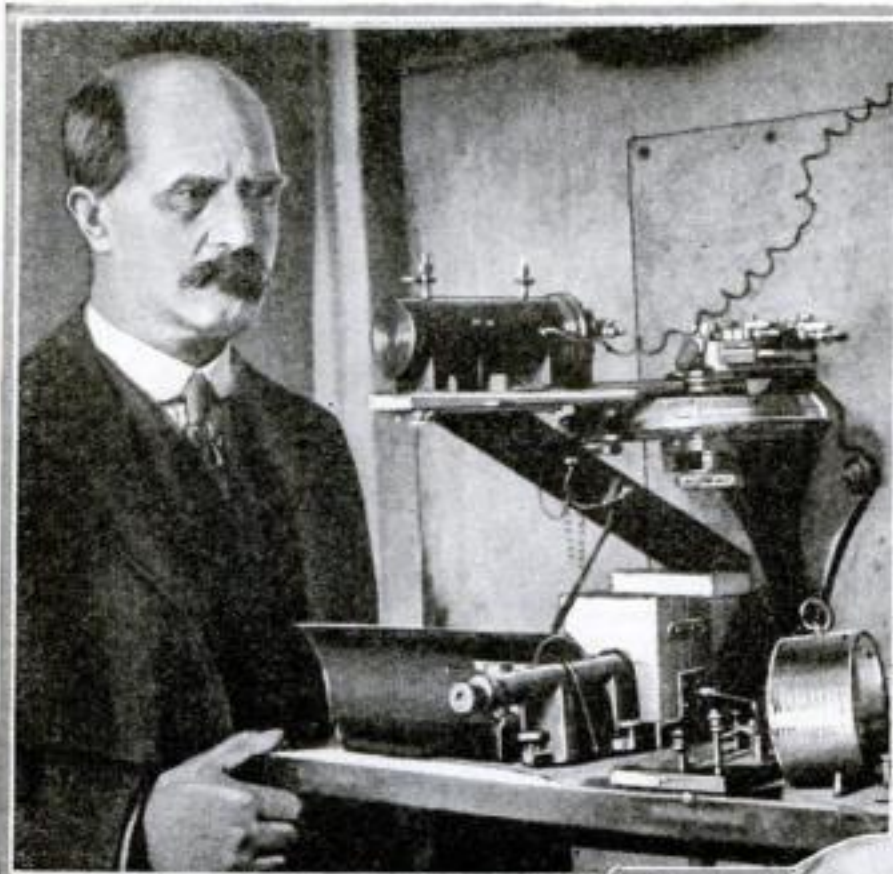
Please send me your free booklet "Be a Power In Electricity." This request puts me under no obligation.

Name

Occupation

Address

Men of the Hour in Science



© K. & H.

SIR WILLIAM BRAGG, one of England's leading scientists, at work in his laboratory at University College, London, with his wonderful instrument called the "X-ray spectrometer," by means of which he is attempting to fathom the secrets of the mighty, infinitesimal atom. He is one of the world's scientists who, through researches into the construction and action of atoms, are revolutionizing the study of physics, making it possible to study the nature of the universe from the smallest particles of matter

DR. LEANDER TOMARKIN, a young Swiss biologist, recently announced the discovery of a cure for pneumonia. He calls his remedy "antimicrobum," a chemical compound that is said to have reduced pneumonia mortality from 35 to 2 per cent. He is shown below in his laboratory at the Holy Ghost Hospital in Rome, where he is reported to be testing a remedy for tuberculosis



Dr. Leander Tomarkin



CHARLES GREELEY ABBOT, D.Sc., astrophysicist of the Smithsonian Institute, Washington, D. C. With the aid of a giant, 100-inch reflector at the Mount Wilson observatory, California, he has succeeded in measuring the heat of stars to the hundred millionth of a degree. Doctor Abbot is shown above with a sensitive heat-measuring instrument called the "pyrheliometer," which he invented for his researches. It is based on the same principle as the little black-and-silver vanes, revolved by light, often seen in opticians' windows



FRIDTJOF NANSEN, D.Sc., D.C.L., Ph.D., F.R.G.S., world-famous Norwegian arctic explorer, author, educator, scientist, diplomat, and winner of the Nobel peace prize in 1922. He now is a leader in organized effort to rehabilitate the war-devastated nations of Europe, and in this interest recently visited the United States on a lecture tour

SAMUEL WESLEY STRATTON, B.S., D.Sc., new president of the Massachusetts Institute of Technology, and for 21 years director of the United States Bureau of Standards, declared, in a recent statement, that "there is a great and growing need for men trained in methods of investigation as applied to the industries," and that "we need men skilled in physics and chemistry, who can appreciate problems that are to come with industrial progress." On the engineer and scientific investigator, he said, depends largely the commercial and industrial progress of the United States

J. WALTER FEWKES, Ph.D., LL.D., director of the Bureau of American Ethnology, Smithsonian Institute, Washington, D. C. He has contributed largely to our scientific knowledge of the races of men that have inhabited the American continent, especially the Hopi Indians and Cliff Dwellers. He is shown below examining a piece of bread more than 500 years old, dug from Indian ruins



Dr. J. Walter Fewkes



"The coming of a friend from a far-off land - is this not true joy?" Confucius -

Your friends of radio come to you each night through

the **GREBE**

Broadcast
Receiver.

Doctor M.

THE GREBE CR-12 Broad-
cast Receiver is a highly
efficient Radio Instrument em-
ploying both Regeneration and
Tuned Radio Frequency Ampli-
fication with only two tuning
adjustments.

A Dial graduated in wavelengths
enables you to locate the program
you desire instantly.

Compartments are provided for all
necessary batteries in the attrac-
tively finished walnut cabinet.

Requiring no cumbersome storage
battery nor unsightly wires, this
Instrument will grace your library
or living room.

Write for "GREBE
Radio in the Well
appointed Home"



GREBE RADIO

A. H. GREBE & COMPANY, Inc.
Richmond Hill, N.Y.
Western Branch, 451 East 3rd St., Los Angeles, Cal.

Licensed Under
Armstrong U. S.
Pat. No. 1,113,149



Type CR-12



POPULAR SCIENCE MONTHLY

SUMNER N. BLOSSOM, Editor

February, 1924



Edison, the Man

An Old Friend's Intimate Recollections of the Great Inventor

By Francis Jehl

YOU probably read in the newspaper the other day that Thomas A. Edison had sent for an old Michigan fiddler, Jep Bisbee, to come East so that phonograph records might be made of the jig tunes he had played for Edison, Henry Ford, and Harvey Firestone when they were on their camping tour last summer.

For me there was a great deal more in that story than the papers printed. That Edison had not forgotten a promise made half a year ago to a casual acquaintance of his vacation jaunt who wanted to hear his tunes on a phonograph, told me that he still remains the same great-hearted, considerate, thoughtful man he was 45 years ago, when I started working for him as a lad of 18 in his historic laboratory at Menlo Park, N. J.

We read so much of Edison as the electrical wizard and the world's greatest inventive genius, that most of us, I fear, have lost sight of the fact that he is a human being as well—a broad-minded, sympathetic, kindly man who reads the newspapers to see what his fellow men are doing, who enjoys a clever joke and a good cigar, and who derives as much wholesome fun out of life as any man alive.

A Thoughtful Man

That little incident of the old Michigan fiddler is typical of the Edison I know, the man who always is looking out for others and trying to make them happy. It brought to my mind the memory of my first meeting with him and the surprise I got to find him the very opposite of the cold, austere scientist I had pictured him.

I had been reading law at the office of Grosvenor P. Lowery, counsel for the Western Union Telegraph Company. He noticed that my principal interest lay in briefs concerning electrical patents. One day he asked me about this, and I admitted that I was more interested in electricity than

FORTY-FIVE years ago, Francis Jehl, then 18 years old, went to work for Thomas A. Edison as a laboratory assistant. Mr. Edison at that time was experimenting with the incandescent lamp and had a staff of seven men. Mr. Jehl is the only survivor of that staff, the only man living except Mr. Edison who saw the birth and development of the lights we all use today.

Mr. Jehl has been in the Edison organization since the day in 1879 when he was chased into Mr. Edison's office by a pet bear the great inventor kept in the yard of the lamp works. He now is connected with the Edison Museum in New York City. He has been in constant touch with America's greatest inventor for nearly half a century, and knows his chief as few other men are privileged to know him.

in law. Mr. Lowery knew Thomas Edison as the inventor of the stock ticker, the quadruple telegraph, and other devices bought from him by the Western Union. He was convinced of Edison's genius and

had been quietly enlisting the financial backing of such men as J. Pierpont Morgan, E. G. Fabbri, Robert F. Cutting, and Henry Villard for Edison in the latter's experiments on a new type of electric lamp. He gave me a letter to Edison, and one day I took a train to Menlo Park to present it.

Menlo Park, then as now, was an obscure little hamlet on the Pennsylvania Railroad, a few miles from Rahway, N. J. People who have traveled on Pennsylvania trains between New York and Philadelphia doubtless have seen the station as they whizzed past. The main street was all but deserted that day as I hurried toward the long, white-painted, two-story frame house that was Edison's laboratory.

I was thrilled, and more than a little awed. I was about to see the greatest inventor in the world! More than that, Mr. Lowery had told me that Edison was agreeable to my joining his laboratory force, if I could qualify. You can imagine how my heart was thumping; how I was besieged by fears and misgivings as to the sort of impression I might make on Mr. Edison.

Edison's "Pet Dog"

As I approached the front porch I caught sight of a great shaggy mass lying under a giant hickory tree beside the house.

"Ah!" I thought. "Mr. Edison's pet dog!"

It occurred to me that I might win some slight favor with Mr. Edison if I could make friends with his dog, so I thrust out my hand to pat the animal. The next instant I was rushing up the stairs of the laboratory, the worst scared young man who ever had entered the place. For the animal under the tree was a brown bear. It was chained there; but I didn't take time to ascertain that fact. I just ran.

I forgot all my carefully rehearsed speeches, forgot everything I had planned to impress Mr. Edison. I



Thomas A. Edison.

An unusual portrait of the great inventor as he appears to-day



The historic laboratory and lamp factory at Menlo Park, N. J., where in 1879 Edison and his assistants manufactured the first incandescent lamps in the world

dashed into his laboratory, panting and dishevelled, looking apprehensively behind me for the beast which I felt must be at my heels. I had intended to be dignified. Instead, I was funny and, I fear, ridiculous.

Mr. Edison laughed heartily when I burst in on him, but it was a laugh that endeared him to me forever—a sudden, swift revelation of his character. There was no ridicule in the laugh; no trace of enjoyment of a boy's embarrassment. It was just a wholesome, hearty, spontaneous burst of merriment such as any comical happening might cause.

"Well, son," he said, "did the bear chase you in? Don't let that bother you—you're not the first one."

In an instant I was at my ease, and within a very few minutes arrangements had been made for me to join Mr. Edison, an association that has continued without interruption to the present day.

Six others besides myself were at the laboratory, aiding Edison in his experiments with the incandescent lamp. He was entering his thirties then—an earnest young man with a determined, purposeful face, crowned with that same mop of hair that is silvery now. We worked. Mr. Edison had a faculty for getting things done and for keeping his force inspired with the same enthusiasm that actuated him. Yet not one of us ever thought of him as "the boss." For he was no driver. He had—and has—executive ability—a faculty for handling men in a degree possessed by no other man I ever have met. Sometimes it would take half a day to



A group picture of Edison surrounded by members of his family and his laboratory assistants, taken in 1879. Beside him are his two children, Marion and Thomas, Jr.—nicknamed "Dot" and "Dash." The white-haired man is Samuel Edison, the inventor's father. Francis Jehl, author of this article, is the third man from the left in the top row



The Edison of 1879, described by the writer as "an earnest young man, with a determined, purposeful face"

Here, 45 years ago, the writer of this article, then a lad of 18, went to work for Edison and took part in his early struggles for recognition and commercial success

mount a filament in a lamp—and then it wouldn't work. The man who had done the work often would be discouraged to such a point that he was ready to give it all up—to leave the development of the incandescent lamp to somebody else with hardihood enough to continue such unsatisfactory work indefinitely. That mood, though, never lasted long when Mr. Edison entered the scene. His eyes would twinkle as though the unsuccessful experiment were just a joke.

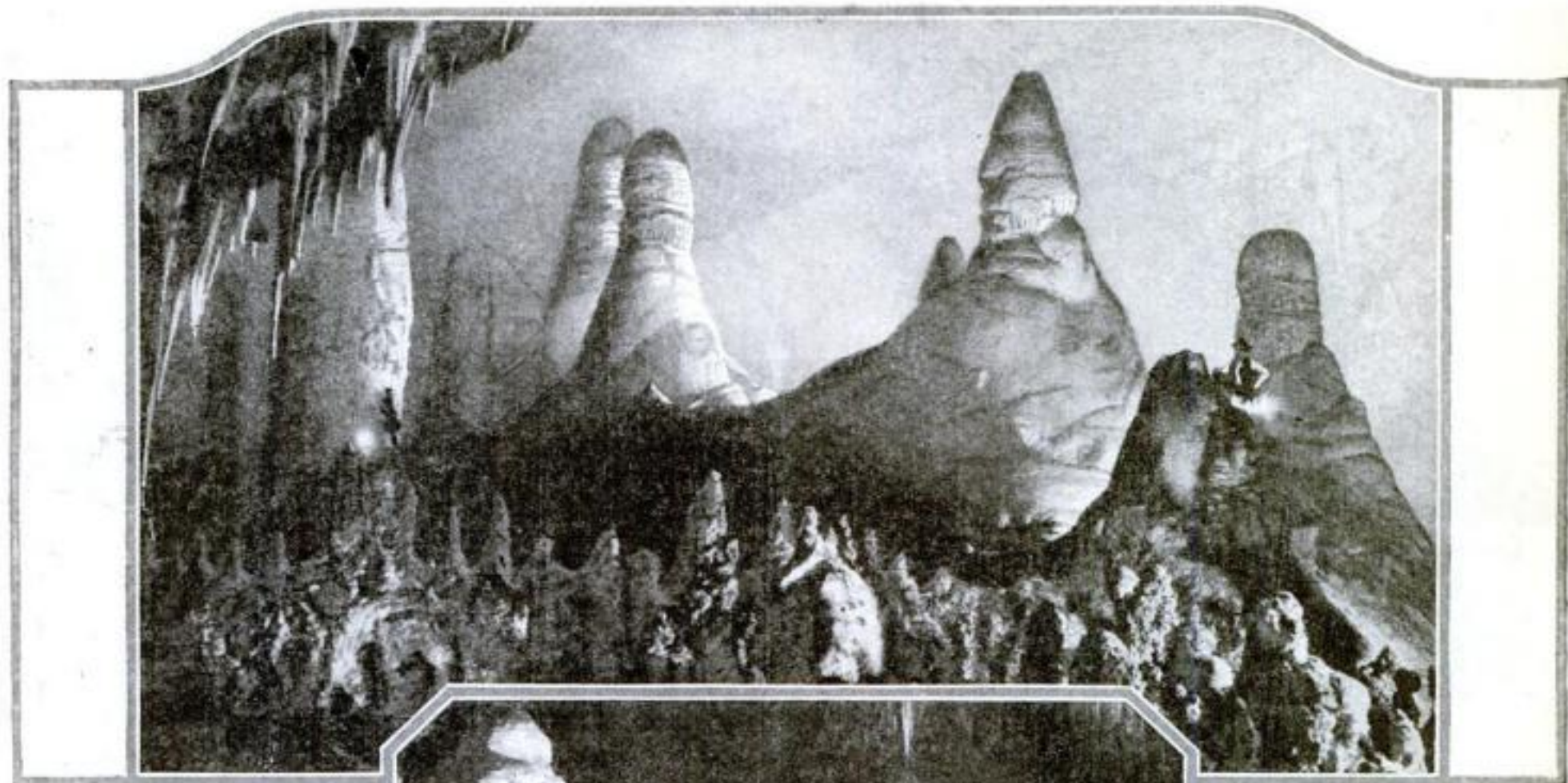
"Well, now," he'd say, "we'd better try that again. Maybe this time we'll find out what's wrong with it."

And that's the way the incandescent lamp was invented—experiment after experiment; tireless search for the reason for failure; attempts to correct mistakes. And always the indomitable spirit of Edison triumphed over setbacks and discouragements, inspiring his assistants with faith in his purposes and confidence in his ultimate success.

You have read that Edison is a tireless worker. No man ever worked harder and more relentlessly than he did in those early days. And by the magic of his personality he kept us all working with him, heedless of discomfort or fatigue, interested only in the work we were doing, and reluctant to leave it until it was done. Night after night we stayed at the laboratory until the gray light of the new day drifted in through the windows. Mr. Edison would toss a few books on a bench or

(Continued on page 140)

Exploring World's Greatest Cavern



One of the great chambers of the Carlsbad Cave, shown above, is more than half a mile long. Columns range from the length of a needle to heights greater than 100 feet. The ceiling is more than 300 feet high



Except for millions of bats, the great Carlsbad Cave shelters no animal nor vegetable life. In the early morning and late afternoon the echoing darkness is vibrant with the beating of their wings as they dart among the grotesque formations

The slow seep and drip of mineral solution through incalculable ages shaped the weird architecture shown below. Drips from the vaulted ceilings built up the dark stalagmite rising like a pillar in the foreground, and the stalactites that hang from the ceilings like huge icicles



Below are shown two massive columns rising to a height of 70 feet above the floor of the cavern. They are dark green in color. Unusual formations of smaller stalagmites, ranging in color from light cream to dark brown, are shown at the left center



WITH fantastically beautiful rock formations and cathedral-like chambers glittering in a hundred shades of color, this vast cavern near Carlsbad, New Mexico, is believed to be the largest ever discovered. Although its existence had been known since 1901, when swarms of bats were seen to fly from a hole in the side of a hill, it was only recently that its interior was explored by scientists of the United States Geological Survey.

A small party, headed by Dr. Willis T. Lee, entered the lofty chambers while seeking to discover why waters impounded in dams along the Pecos River disappeared underground. One of the enormous rooms was found to be half a mile long and a quarter mile wide.



How the Followplane, gigantic seaplane cruiser to be constructed at Cleveland, Ohio, will appear when completed. This drawing is based on the designers' plans. The giant lines will be 170 feet long, and will be designed to carry 100 passengers and 2½ tons of express freight

Whole World in Race for Supremacy in the Air

By Donald Harris

THE swiftly moving airplane of today, with its one or two specially trained occupants, soon may share its dominance of the air with the slower-moving commercial liners and the more versatile helicopters of tomorrow, just as the specially constructed racing automobiles of 20 years ago moved over to give road room to the utilitarian cars of today.

Epochal Advances in Aviation

Epochal advances in aviation are in progress. The air flivver already is here. The helicopter and the gigantic air cruiser for freight and passengers are on the way.

In France recently M. Oehmichen flew for nine minutes in a helicopter designed by him, rising 35 feet and circling a course. This set a record in vertical flight, more than trebling the best previous feat. A few weeks later, in another type of helicopter, the Marquis Pescara accomplished a flight of nearly six minutes. Throughout France helicopter development is receiving the enthusiastic attention of the most eminent aeronautical designers.

In England and Germany, tiny planes analogous to low-priced automobiles enjoy the focus of expert attention.

In the United States, birthplace of the airplane, giant planes, such as the

army's Barling bomber, and great dirigibles, such as the navy's *Shenandoah*, have become the goal of our most distinguished designers.

Among the latest developments in these countries, remarkable are the Halley helicopter in France, shown on the cover of this issue, and the gigantic Followplane aerial cruiser to be constructed in the United States, the design of which is shown in the drawing at the top of these pages.

The new helicopter designed by Charles Halley, a noted French engineer, conceivably may revolutionize aeronautical design. Although this machine exists only as a model, the radical yet apparently sound departures embodied in it have engaged the keen attention of experts everywhere. A successful helicopter would obviate the need for flying fields. Helicopter hangars on office-building roofs would make it possible for business men to commute 100 miles by air and to land the distance of an elevator ride from their offices.

On the Halley machine two bell-shaped wings are attached to a car resembling an airplane fuselage. Two motors in this car drive two propellers revolving in a

vertical plane on each side, drawing air from above the machine and driving it against the curved under surfaces of the wings.

By deflecting the air downward, the wings exert an upward push. Combined with the suction obtained by drawing air from above, this push is said to raise the craft swiftly and vertically.

Tilting the wings ejects the air from the propellers rearward as well as downward. This, the inventor claims, produces sufficient force both to keep the craft aloft and to drive it forward.

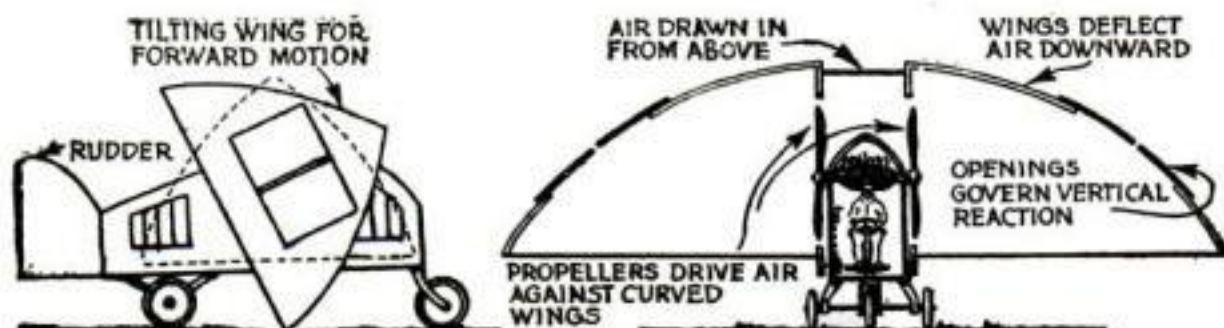
Directed by Controlled Air Currents

In addition to the steering lever, there is a vertical control lever that opens and closes openings in the center of each curved wing. When these holes are opened, part of the air driven against the wings will escape, lessening the vertical propulsion.

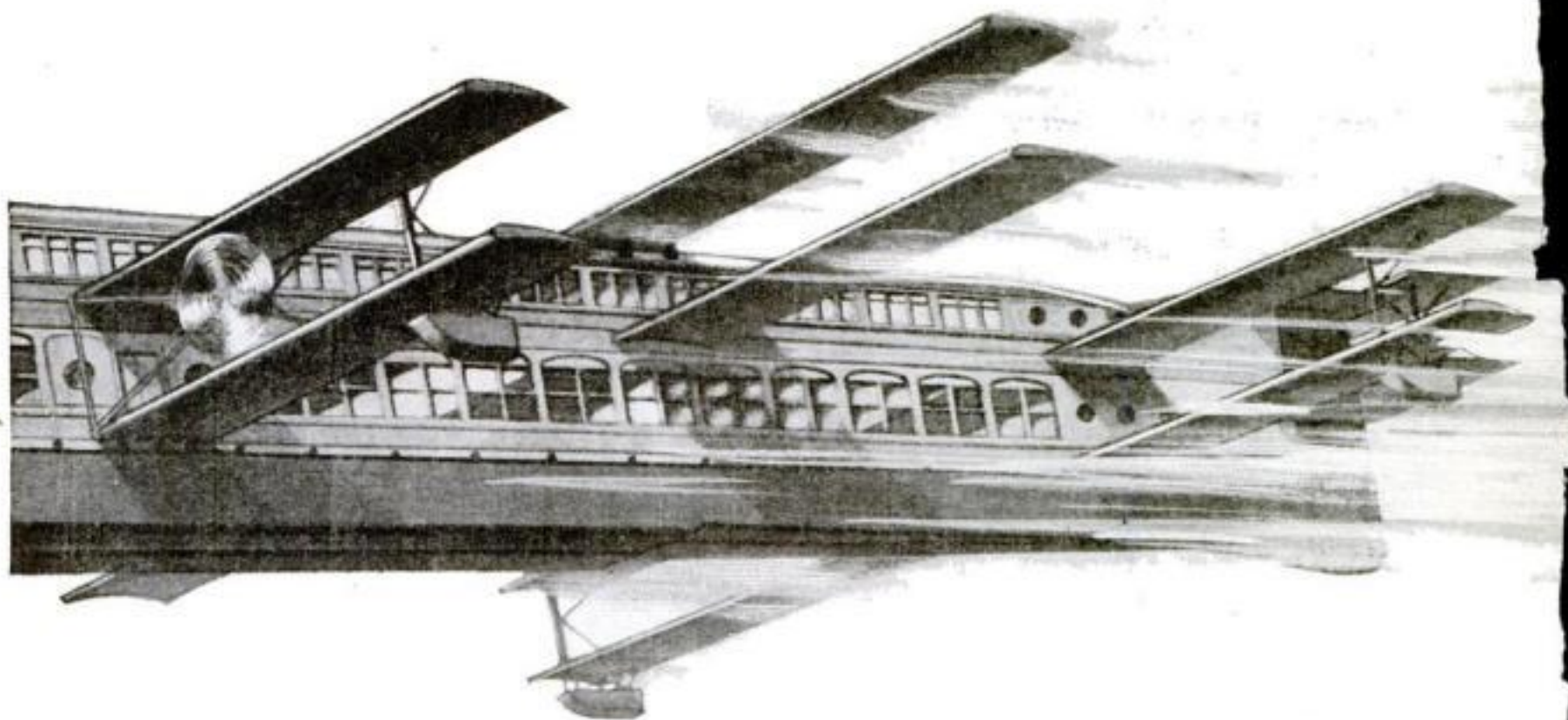
A wider opening is said to cause the machine to hover, practically motionless. And, finally, a still wider opening, the inventor claims, will cause the machine to descend.

It is claimed also that the parachute shape of the wings makes the Halley helicopter comparatively safe, even if the motor should fail.

The huge Followplane air cruiser, designs of which were completed recently by Thomas R. McMechin, once a Zeppelin engineer, and Lt. Arthur Dennison, for-



Diagrammatic views, side and rear, of the revolutionary parachute-like helicopter designed by Charles Halley, French engineer, and pictured on the cover of this issue. Its principle consists of drawing air from above and driving it against the wings to produce upward motion



mer United States Army designer, truly is a remarkable machine.

This gigantic freight and passenger plane, by far the largest ever seriously projected, is to be built at Cleveland, Ohio. It is to be all of metal, 170 feet long, 26 feet from keel to top. It will contain 2500 square feet of floor space and will fly with six staggered pairs of wings, each with a span of 61 feet. Six engines, of 900 horsepower each, will drive six propellers. These engines will be paired, only two operating at the normal cruising speed of 125 miles. The other four will be reserves. It is estimated that a speed of 200 miles an hour could be attained with all six engines operating.

This aerial giant will be a seaplane, capable of rising from and landing on water. The great length of the wings and their staggered arrangement, combined with the weight of the plane, is expected to allow the machine to travel through severe weather with no more than a very slow roll. All combustible supplies will be carried in an airtight compartment, which can be flooded instantly with carbon dioxid in event of fire.

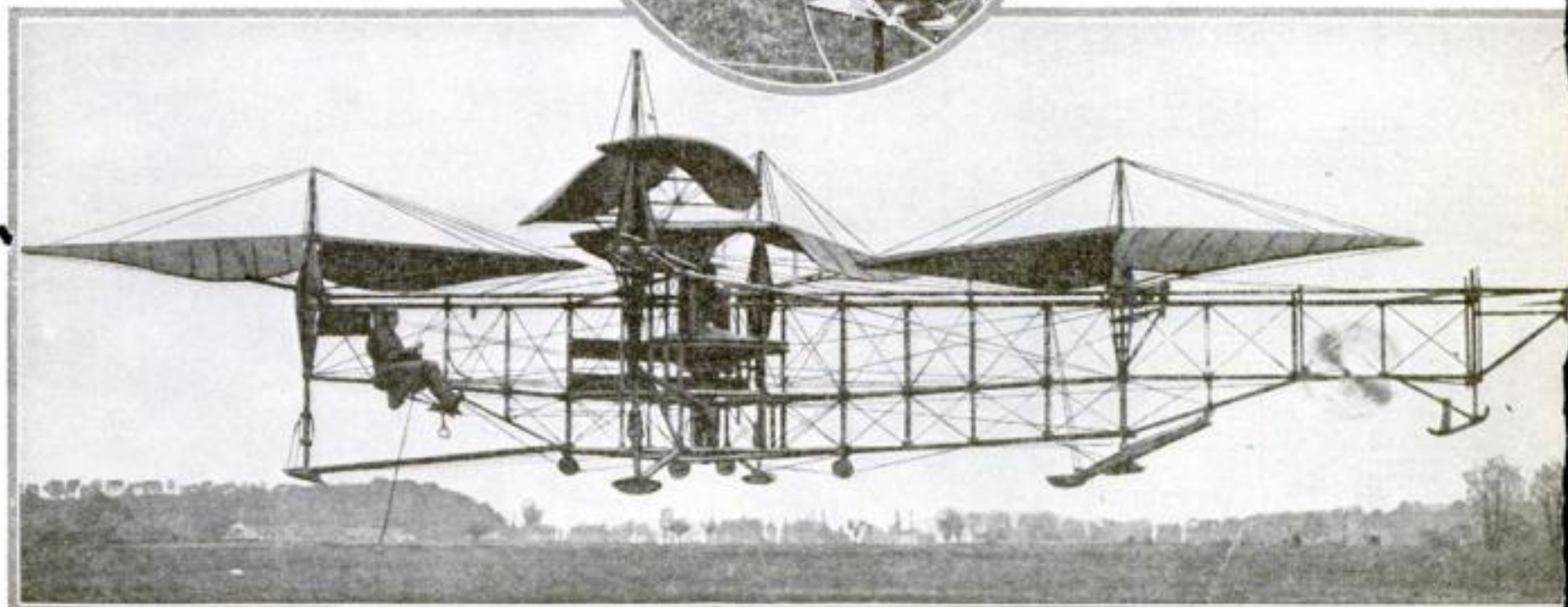
The engines embody numerous radical departures in internal combustion design. They will burn fuel oil, a feature that is expected to reduce their operating cost. It is claimed further that they cannot backfire. Power is transmitted to the propellers through a hydraulic system.

When completed, the great air liner is expected to shorten the traveling dis-

tance from New York to London to less than 24 hours, at the normal speed of 125 miles. An American man could leave Washington one day and keep a speaking engagement in London the next evening. Chicago to New York would be only six hours apart. It is estimated that a \$35 fare would enable the craft to pay a profit on this route. The transatlantic journey, a fare of less than \$150 would be adequate, it is believed. At least 100 passengers and tons of express freight could be carried.

Staterooms with berths will make night travel feasible, and dining accommodations will be provided. Passengers will not need to remain in seats throughout the journey, as in present passenger planes. Even dancing could be provided, the designers claim. Because of the all-metal construction and fireproof compartments, smoking will be allowed.

The Halley helicopter and the Fokker plane both represent new milestones in man's swift conquest of the air. Other aerial models await only the working out of constructional details.



The new helicopter invented and operated by M. Oehmichen, shown in flight during a recent trial near Valentigney, France. The machine rose 35 feet on a circular course, remaining in the air for nine minutes, breaking all previous records for vertical flight. The inset shows the inventor at the controls.

Our Senses—and Common Sense

Second Article in "The Story of the Mind"

By James J. Walsh, M.D., Sc.D.

my newspapers and magazines a blind man, who keeps a news-stand near my home. When I tell him what papers and periodicals I wish, he hesitatingly selects them from the rack and hands them to me. He always makes correct change instantly from a pocketful of coins. In the several years I have been patronizing him I never have known him to make a mis-

take, but I cannot but admire the skill and accuracy with which that newsdealer, despite his infirmity, carries on his little busi-

ness. People often explain the apparent mystery of it by saying that nature has compensated him for his loss of sight by sharpening his other senses, especially his sense of touch. But that is

not a test by the esthesiometer, an instrument for estimating delicacy of touch. A blind man is shown to be no more sensitive than the normal person. For example, the blind man is not at all superior in recognizing, as two separate sensations, two needle points that prick him at points very close together. He has learned, though, to pay attention to minute differences in feeling and to recognize them, and he knows through experience what he expects to feel. Thus he is able to differentiate unerringly the pennies, nickels, dimes, and quarters in his pocket, and the magazines and newspapers on his stand; things which all of us could do quite as well if only we would concentrate on using our senses as they should be used.

How We Neglect Our Senses

Neglect of the unused resources of our senses is one of the great handicaps we lay upon ourselves. Have you ever taken your watch from your pocket, glanced at it, and then, a few seconds later, found yourself unable to tell another person the time? Can you at this moment, without referring to your watch, write down the numerals on the dial exactly as they appear? Try it and see. Unless you have heard of this test before, I venture to say that in the thousands of times you have looked at your watch you have failed to observe that there is no numeral 6; that the place that numeral 6 should occupy is filled by the second dial. And, if there are Roman numerals on your watch, I wonder if you have observed that instead of "IV" the numeral is inscribed "IIII"?

Do you know the color of the eyes of a person who sits beside you in your car or stands next to you in your shop? Can you tell with what words the government marks the value of a 25-cent piece, and on which side of the coin they appear? These are things that you have had



Bereft of sight and hearing since childhood, Helen Keller (at the right) and Willeta Huggins, 17-year-old Chicago girl, have achieved distinction by developing the sense of touch to an amazing degree. They are shown above in conversation. Miss Keller "hears" by placing her finger tips on the girl's lips, while Willeta understands what Miss Keller says by placing the finger tips on her chest and sensing voice vibrations.

hundreds of chances to observe. You may say they are not important; yet observing them in a way that would imprint them indelibly on your memory is a process that requires no effort if you have trained your senses to work for you as Nature intended they should. Such training in observation is an invaluable aid to successful achievement.

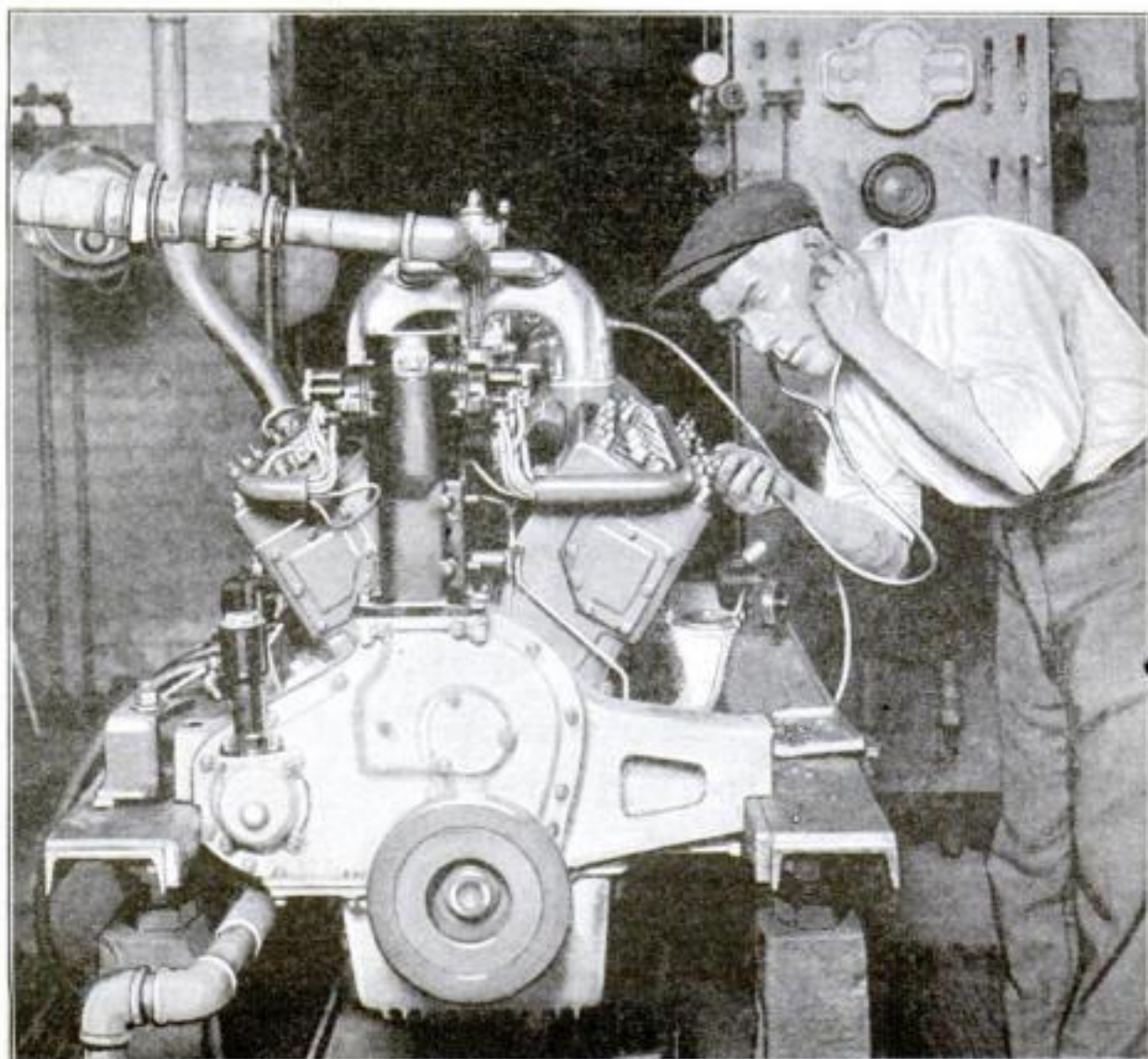
If you have not trained your senses to

record accurately every impression they receive, you have placed an insurmountable barrier before the storehouse of your mind. For the senses are the gateways of knowledge; the only entrances by which the mind can receive the stimuli, without which, as I pointed out in the previous chapter of this series, the mind will not work.

Only through impressions received by your senses can your brain store up the facts and information that mean skill at your trade, expertness at your profession, scholarship in education, a trained mind for life.

The oldtime philosophers had a maxim well worth recalling: "There is nothing in the mind except what was beforehand in the senses." What they wanted to emphasize was that we are not born with ideas. We have instincts designed to enable us to live, and reflexes intended to protect us against dangers in early life; but we have no ideas. They have to be acquired.

It would be mighty handy for some of us if we could inherit the education of our parents, and, beginning with that basis, add more. Dr. Oliver Wendell Holmes praised Emerson as the seventh generation of an academic family, yet that hereditary quality did not add to Emer-



Testing an automobile engine in the plant of a Detroit automobile company. By concentrated training of his sense of hearing, the skilled mechanic who makes the tests has learned to detect the least flaw simply by listening to the sounds of the running engine through a stethoscope.

ment, much less confer-
ation on him at birth.
environment, undoubt-
facilitated his
ation, but his
dity did not.

our father and
her both may
known Greek
or mathematics;
that will not
it any easier for
to learn either
thematics or
sk. On the other
i, your ancestors
have been un-
ated drawers of
er, hewers of
d, or tillers of the
for many genera-
s; yet it is pos-
for you to make
s and drakes of
scion of an aca-
ic family who

ces to start his education at the same
you do.

other words, what you know, what
learn, what you eventually amount
are a result of what you yourself
ire through your senses. Hence, the
ssity for training the senses.

early life the untrained senses are
st useless. The child reaches out to
the moon because its senses have
yet been trained to perceive that,
gh the moon is very bright, it is too
way to be touched.

e Chinese Train Their Senses

little later in life this same child, as a
t of experience and training of the
s, may be able, with one glance at a
raper, to tell you how high it is
n a foot or so. They say that when
nese carpenter is summoned to make
rs, he looks at what has to be done,
goes back to his shop and cuts the
ls so that they will fit exactly into the
on that is to be repaired. He has
ed his sense of sight to give him
knowledge.

now a real-estate man who can go
gh a large building and tell you,
he comes out, the exact size of
ooms and how they are situated.
exceptional man? Not at all.
nerely has trained his senses to



Above: A psycho-
logical test in judg-
ment of space varia-
tions for the young
man who is to enter
an engineering shop

At the left: Inspect-
ing finished artificial
leather as it comes
from the coating ma-
chinery in a factory
at Newburgh, N. Y.
The trained vision of
the girl inspector de-
tects the smaller
flaw in the movin-
sheet of the fab-

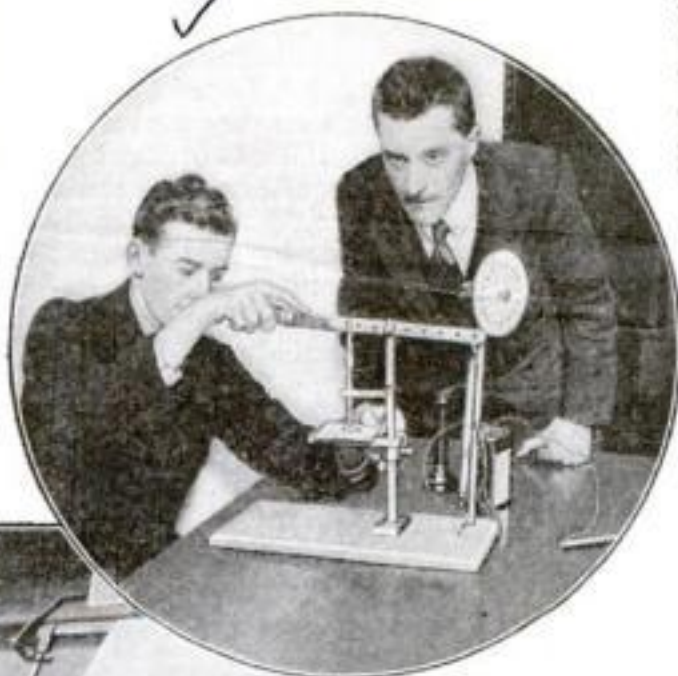


Tea tasters employed to grade imported teas and for the collection of customs duties,
require a highly developed sense of taste. They command high salaries accordingly

perceive things accurately, and his mem-
ory to retain whatever they taught.

Go into a telegraph office and listen to
the busy clatter of the receiving instru-
ments. It all seems a meaningless jumble
of sounds to you, yet the operators sitting
beside the instruments are ticking off on
their typewriters the meaning of those
sounds in ordinary English at the rate of
more than 100 words a minute.

Can they hear any better than the rest
of us? Not at all. On the contrary,
their hearing often is worse than the
average, because the constant effort is a
strain on the delicate hearing apparatus.
They merely have trained their sense of
hearing to catch the meaning of those
sounds. After all, this is no different
from learning a foreign language.



When the telegra-
cumbrous printing a
ing the signals went
extremely slow in of

P
t
h
r
e
s
d
n
c
t

p
tr
t
b
n
c
s
T
t
tr

any sense will achiev

There is a very c
country storekeeper w
the different solid co
as red and blue and v
concerned—by touch
seems almost imposs
cacy of touch could b
are considerations t
preciate exactly how

If you were to ta
red, blue, white, an
same weight and
them out on a wind
fallen layer of snow,
on them, the sno
different colored sq
varying times. Th
be the first to touch
reason for this is tl
the rays of the su
therefore it takes up
other colors. White
of the sun and not
That is why light
more suitable th
wear in the s
tropical countries
light and heat tha

Can You

The storekeep
differentiate amon
cloth by the diff
ture which they
varying power c
flecting heat.
concentration of
plish his purpos
tration is the o
lock the gatewa
lead to the min

What that r
have done m
but, becaus
necessity
your
you
re

of the same weight. The metal is colder than the wood of an pencil. Similarly, you would at the first touch, the difference between a conventional pencil and a metallic pencil. You can tell at once whether an object is of metal or of wood or of composition, by the sensation presented to your sense of touch.

Although your eyes are closed, you do not desire to feel if you wish to determine a column in a stone or of some metal. You touch the tips of your fingers and recognize almost at once, through the cold sensation, the difference in the object. Of course, the actual difference in

Touch Sense

and a metal tube lying on your desk several hours, they are at the same temperature. The temperature of the metal is a factor of heat than the metal tube carries on your hand faster than this fact at once. Immediate recognition of the difference between them, may be of the same weight and present the same feeling of the object to the hand. The fact is true of the pillar of plaster and the pillar of stone.

Nature has provided you with wonderfully sensitive and delicate faculty of recognizing different objects through their different physical qualities, merely by touching them. These qualities, such as smoothness, shape, and temperature transmit their messages to the touch. Doesn't this cause you to wonder whether our sense of touch may not be several senses?

Recently the conclusion that has been reached as a result of modern research. Instead of the five long-established traditions of us, modern psychology says actually 25 or more, each independent of the other, each performing individual functions and leading to the assimilation of impressions which are stored away in the memory knowledge.

Telephones

25 different
pick

We have a sense for cold, another one for heat. We may lose one without losing the other. We have a sense of pain, too, which we may lose without losing our sense of contact. Some years ago I saw a man enter the Salpêtrière Hospital in Paris suffering from a badly burned finger and thumb. He had become engrossed in conversation with a friend and had per-

senses of touch, each no more connected with the others than the eye nerves are connected with the hearing.

This discovery is of real practical value to us. It shows us that what we call our sense of touch, which we regard simply as a blunt purveyor of sensations, actually is capable of being trained to bring us the most delicate details of information and to serve as a highly useful auxiliary to what may seem the senses of sight and hearing.

The powers of the blind news-dealer I have mentioned illustrate vividly the really amazing possibilities that lie in full use of the sense of touch. Probably more remarkable still is the familiar case of Helen Keller, who, deprived of both sight and hearing by an attack of sickness in babyhood, and seemingly fated to remain a hopelessly ignorant and dependent human being, successfully completed a college course, won a doctorate of philosophy and has achieved distinction as a writer and lecturer. All of this she accomplished entirely by means of her sense—or senses—of touch.

Triumph over Blindness

Laura Bridgman, the young poetess of Buffalo, is another blind and deaf person who has triumphed over the cruelties of nature through training of the sense of touch. It will be remembered, too, that Homer, one of the first and greatest of the world's poets, undoubtedly was blind. So was the great Milton.

But the usefulness of the sense of touch is not confined to those who are deprived of other senses.

I know a cloth merchant who can tell the value of cloth to within a few cents a yard by feeling it. He can tell how many threads it contains to the inch. He knows instantly whether the material is pure wool or wool mixed with cotton; whether it is pure silk or one of the recently invented artificial silks; whether it is loaded with metallic salts that add apparently to the body of the material but make it likely to crack and to be short-lived in wearing. He knows the strength of the fiber, whether it is short or long.

This knowledge he has acquired only as a result of persistent training, for he entered the mercantile field as a clerk and had no previous experience in any other field. His sense of touch is no better than that of the average human being, but he has learned the priceless habit of concentration and attention.

Study Your Impressions

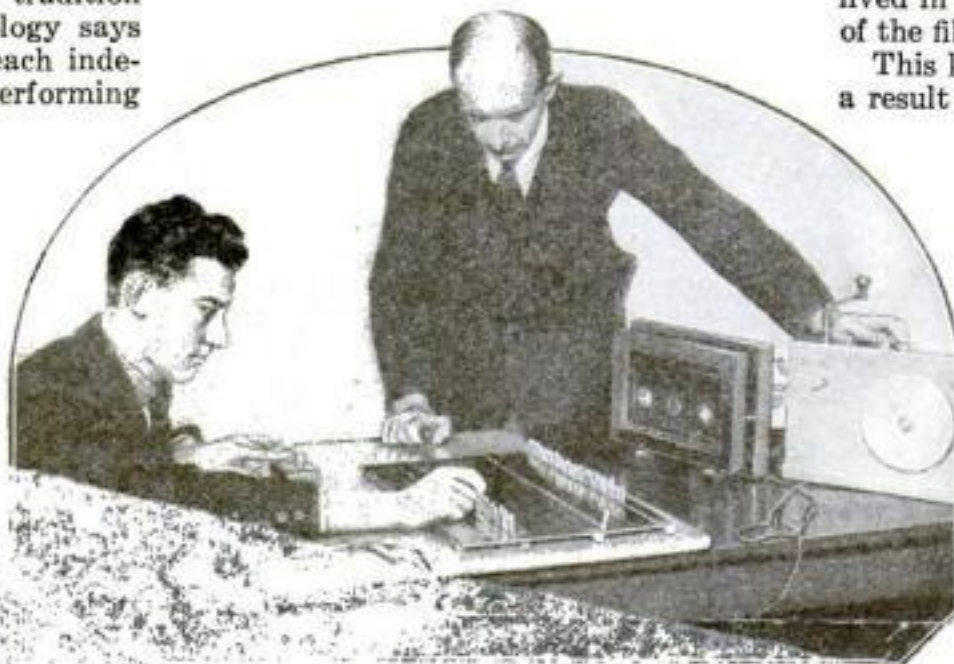
He has learned to interpret aright the impressions his senses of touch receive as he feels a bit of cloth, and to remember those impressions so that he recognizes them instantly when he encounters them again.



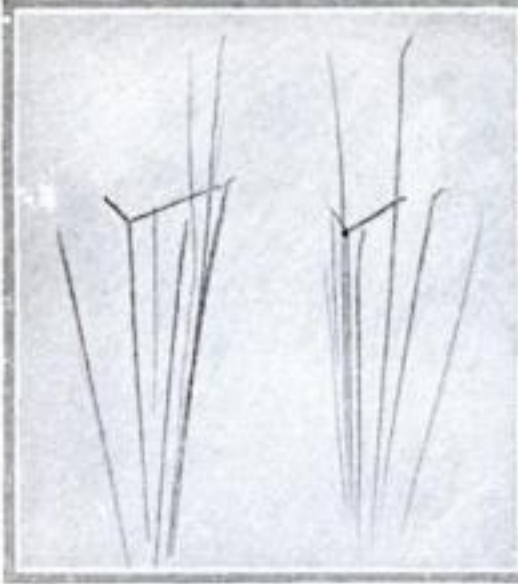
© U. & U.
Mrs. Alice Foote MacDougall, the only woman coffee grading and blending expert in America, at work in her office in New York City. Fifteen years ago Mrs. MacDougall was a penniless widow. Today she is at the head of a large retail and wholesale coffee business which she built up by her own efforts largely through training and developing her sense of smell.

mitted a lighted match to burn his fingers. He did not feel the burn, and was unaware of it until he smelled his burning flesh.

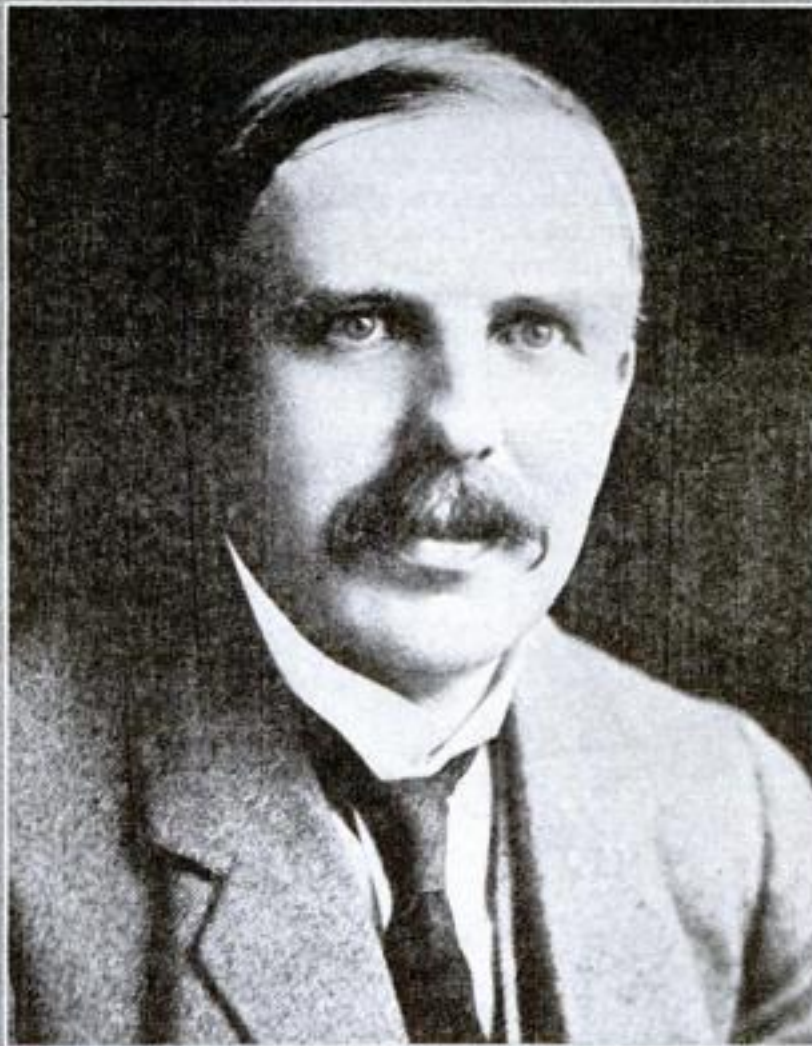
An affection of the spinal cord had cut off some of that man's sensory nerves on their way to the brain. Heat brought no sensation to his fingers, although he could distinguish cold, and could tell one familiar object from another by feeling them. His case supplied the most startling example I have encountered of the fact that we have at least a half dozen different



Amazing Photos of the Atomic Universe



1. Two views of a collision of an alpha particle (helium) with an oxygen atom. The shorter fork shows the trail of the deflected atom. Science, exploring the world of the infinitely small, has found that an atom is a tiny solar system in which concentrated electric charges, called "electrons," revolve at a velocity of 93,000 miles a second about a central nucleus, as the planets about the sun



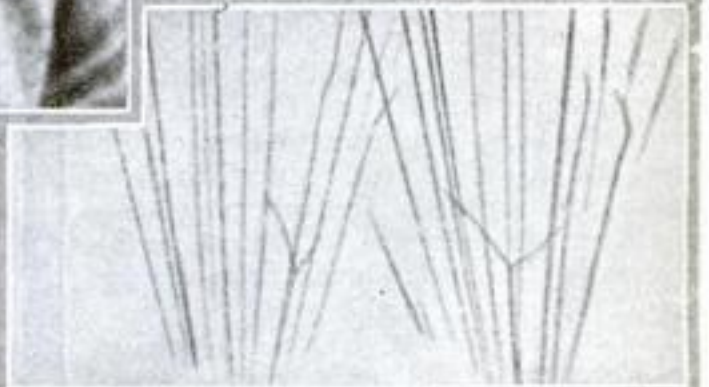
Sir Ernest Rutherford, F.R.S., president of the British Association for the Advancement of Science and one of the world's foremost authorities on radioactivity. In his experiments he plays with atoms as other men play with billiard balls. The amazing photographs reproduced here through his courtesy, illustrate his discoveries in a world invisible to ordinary microscopes



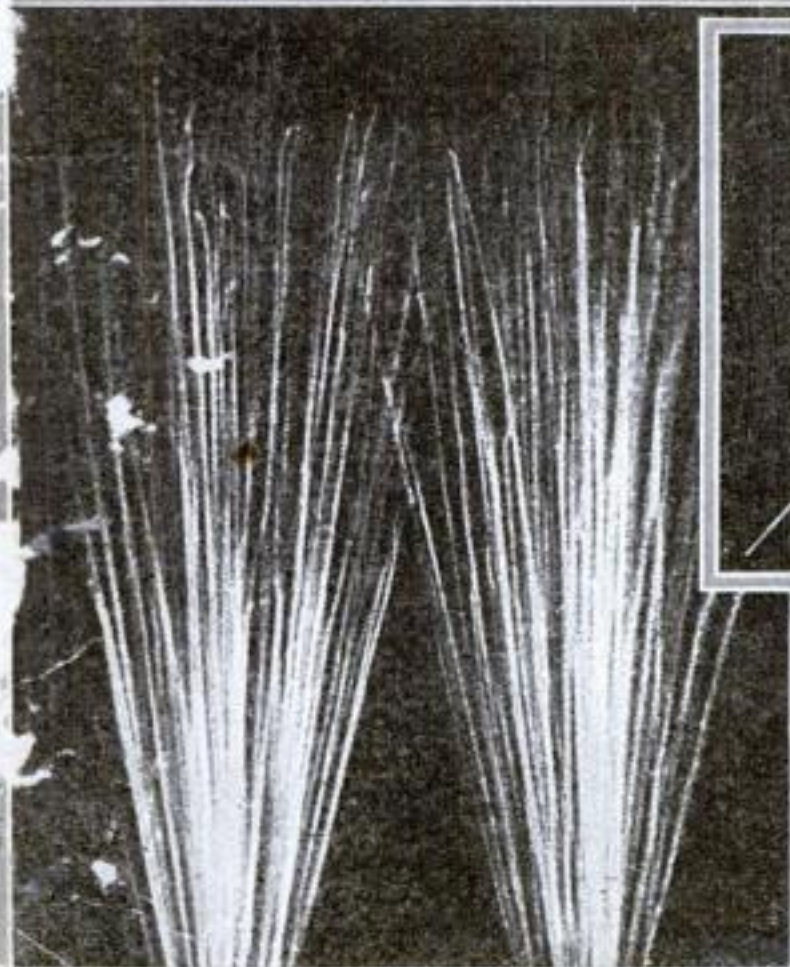
3. Two views showing collision of an alpha particle with a hydrogen nucleus. The left fork shows the track of the nucleus. Scientists say it would take a million times a million times a million hydrogen atoms to equal in size the smallest visible speck that can be weighed in a delicate chemical balance; yet here is an actual photograph of the movement of a portion of such an atom



4. The passage of X-rays through the air. A narrow beam of X-rays liberates electrons from atoms of matter. In each atom there are from one to 92 of these tiny worlds



5. Two views of a collision between an alpha particle and a helium nucleus. Since both have the same mass, the deflection forks are equal



6. Alpha rays in the air from polonium, a radioactive substance discovered in 1898 by Madame Curie. These two spectacular photographs of mysterious radioactive emanations were taken at right angles to each other



2. Path of an alpha particle shot out from an atom of radium emanation. Rutherford's experiments have revealed that the rays given out by radium and kindred substances are of three different kinds—called "alpha, beta, and gamma rays"—and have proved that the alpha rays shot out by radium are none other than atoms of helium gas



7. Collision of an electron with a nucleus of an atom and with other electrons—comparable with a collision between our world and the sun



8. A very weak X-ray, showing electrons liberated at an angle with its path. Although an atom is so small as to be almost incomprehensible to man, an electron is far smaller; yet it obeys orderly laws of the universe

Astronomy from the Cellar

How a Busy Man Makes the Stars His Textbook

An Interview with James Hartness, ex-Governor of Vermont

By Raymond J. Brown

"WHEN I was Governor of Vermont, there were times when the affairs of state assumed proportions that seemed overwhelmingly important. At such times I would go to my telescope and look upon other worlds; then the affairs of men on earth, their intrigues, their ambitions, and their endeavors, became trivial. Then the seeming importance of this world, the states and nations of which are marked off by definite, narrow lines, paled into insignificance in comparison with the vast worlds that lie beyond us; worlds that have no boundaries; worlds whose infinite size we cannot comprehend.

Earth's Affairs Seem Insignificant

"Whenever my troubles get too much for me, whenever I begin thinking that I am carrying a heavy burden, I find solace in my telescope. Properly enough, it is always the small end of the instrument that points toward the earth. A few minutes' gazing into the wonders of the skies, and my affairs are reduced to their proper proportion in the scheme of the unfathomable universe. They become inconsequential, unimportant; hence, why should they annoy me?"

Thus does James Hartness—prolific inventor, successful selfmade business man, former governor of his state, recipient of honors for useful scientific achievement—describe the unique philosophy of life that has come to him from pursuit of his hobby of astronomical observation "from the human standpoint."

An Underground Observatory

Going underground to look at the heavens may seem like a strange anomaly; yet that is exactly what Mr. Hartness does. For on his big hillside estate at Springfield, Vt., he has constructed the strangest astronomical observatory in the world—a subterranean cave of concrete, containing a half-dozen rooms fitted up as laboratory, library, study, office, and retiring and storage rooms. Connecting with his home by a 200-foot tunnel, the cave ends with the observation chamber, a concrete structure from which juts a cast-iron revolving turret that holds his telescope.

In this turret, which is an adaptation of the revolving turret of a battleship, Mr. Hartness conducts his studies of other worlds. There he is shielded from interruption and from distraction by annoyances of the world in which he lives.

His observatory is little short of revolutionary from the standpoint of the orthodox astronomer. In fact, when his first rough plans were shown to astronomers and makers of optical instruments, they shook their heads gravely and assured him that it couldn't be done.

But Mr. Hartness, who had something more than 100 inventions to his credit at

the time, merely listened to the objections and built his observatory virtually as he had planned it. Later he had the satisfaction of hearing from his critics that his instrument produces results that compare favorably with astronomical apparatus of large observatories.

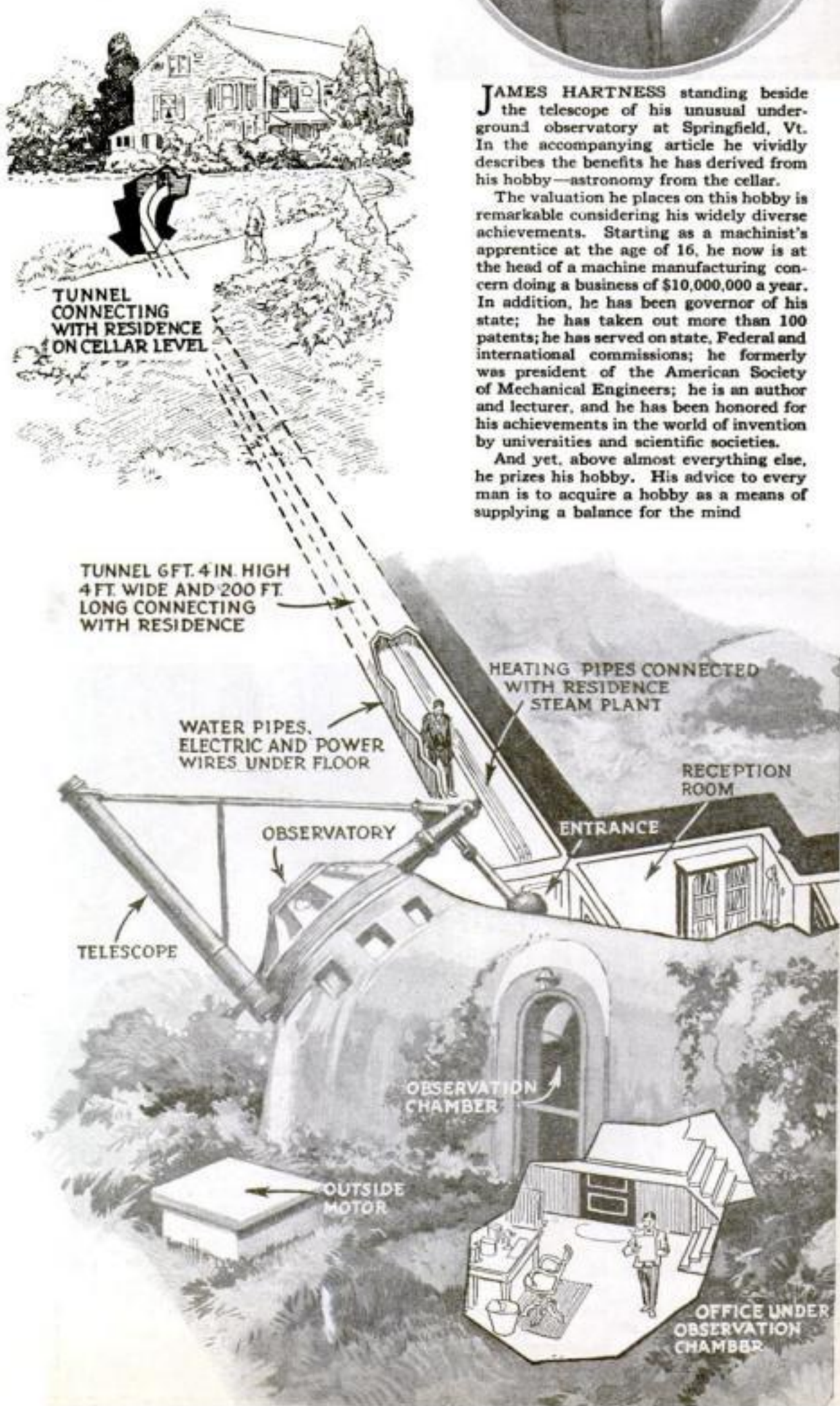
In the cosy study of his subterranean retreat, Mr. Hartness, a tall, wiry, grave-faced man, with kindly eyes, told how



JAMES HARTNESS standing beside the telescope of his unusual underground observatory at Springfield, Vt. In the accompanying article he vividly describes the benefits he has derived from his hobby—astronomy from the cellar.

The valuation he places on this hobby is remarkable considering his widely diverse achievements. Starting as a machinist's apprentice at the age of 16, he now is at the head of a machine manufacturing concern doing a business of \$10,000,000 a year. In addition, he has been governor of his state; he has taken out more than 100 patents; he has served on state, Federal and international commissions; he formerly was president of the American Society of Mechanical Engineers; he is an author and lecturer, and he has been honored for his achievements in the world of invention by universities and scientific societies.

And yet, above almost everything else, he prizes his hobby. His advice to every man is to acquire a hobby as a means of supplying a balance for the mind



Says Dr. Paul Kammerer: The Leopard Can Change His Spots And Fathers Can Pass Their Good Characteristics to Their Sons

By Lane Stuart

THAT acquired characteristics—the deft fingers of the musician, painter, or skilled artisan; the ingenuity of the inventor, the wisdom of the statesman—can be passed on from father to son is the amazing message recently brought to America by Dr. Paul Kammerer, biologist, of the University of Vienna.

An Enthusiast

I called on him the day after he arrived in this country. I found him confined to his bed in a New York hotel, the victim of a recurring fever contracted on one of his early exploring trips in Africa; but even his sickness could not diminish his enthusiasm once he was on the subject of his life work—the endeavor to prove scientifically that the highest qualities we have built into our lives can be passed on to future generations.

Doctor Kammerer has reached his revolutionary conclusions after almost 20 years of scientific experiment with lower animals.

He has grown eyes in blind newts. He has given to land toads the physical characteristics and habits of the water-dwelling branch of the species. He has changed the color of the spots on a salamander's back. Eventually, he says, he hopes to prove that the leopard's spots can be changed in the same way.

Changes Permanent

He has caused certain amphibians to alter their breeding habits. And these new characteristics, produced by patient scientific work on successive generations, he asserts, are made permanent, and are transmitted by their possessors to their progeny, on and on.

"These," he explained to me, "certainly are acquired characteristics, not natural ones. Take the proteus, or blind newt. This animal for centuries has inhabited the dark caverns of the seas. It has had no need for eyes, and its eyes have become mere rudimentary organs under its skin. I exposed successive generations of newts to red light—constantly, night and day—and at



A Second Darwin?

DR. PAUL KAMMERER, biologist of the University of Vienna, has been a storm center of scientific discussion ever since he first announced his revolutionary doctrine of "short cut evolution"—the theory that a son directly inherits the acquired characteristics of his father.

Scientists of world-wide reputation have hailed him as the greatest biologist of his time, the logical successor to Darwin; others of equal standing have been skeptical, and a few have called him a misguided enthusiast.

The attention of the world was focused on Doctor Kammerer when, about a year ago, 50 professors and students at Cambridge University invited him to England to demonstrate his theories.

And now he comes to America to lecture to our leading universities. The accompanying interview is presented in the belief that whether you agree with Doctor Kammerer or not, you will be interested in his theories.

last a newt appeared whose eyes had pushed through its skin. Moreover, this characteristic was transmitted to the next generation.

"If this transmission of acquired characteristics can be effected with some animals, I am convinced that it will apply to man as well. Principles applying to one

branch of life invariably apply to all others—plant life and animal life alike. The discoveries of medical science are the result of scientific work on the lower animals—guinea pigs, rats, and rabbits. Science derives its principles regarding life from the lower animals, then works gradually to man.

Proof from Animals

"It is on this method of scientific research that I base my conclusions. I cannot prove absolutely that the characteristics acquired by one generation of man will be transmitted to the next. Possibly I never shall be able to do so. Man's span of life is too long for one investigator to observe facts regarding several generations. With the lower animals we can do so because they are short-lived—five or six generations live and die in a decade. My hope, though, is to prove this principle of the transmission of acquired characteristics in the lower animals so conclusively that science must accept it as being true of man to the same degree.

"Long after I was convinced by my experiments that it was true, I was gratified by a striking corroboration in the findings of Dr. Richard Semon, a German scientist. Doctor Semon discovered that a child before birth bore callouses on its feet, near the big toe and the heel, where its ancestors had developed them through many generations of walking.

Seeking More Evidence

Callous growths on the feet certainly are an acquired characteristic. This is the only instance I have heard of where the principles I am seeking to prove seem to apply to the human race. One case, of course, is not conclusive. But others will come to light; of that I feel certain.

"It is not in the transmission of purely physical characteristics, however, that the human race is chiefly concerned. I hold also that mental, ethical, and moral characteristics, once acquired, can be made inherent. I believe that every deed, every happening not only leaves an indelible imprint on the individual but is transmitted to the

offspring. Hence, I believe, too, that favorable characteristics produced in one generation through normal life and wholesome environment can improve the human race and result in marvelous progress from generation to generation.

"This is more than eugenics. I may call it eugenics from a positive standpoint, rather than from a negative one. That is to say, instead of seeking to improve the human race by the elimination of bad qualities in succeeding generations, I hold that the improvement should be brought about by inducing positive, good qualities which will be transmitted to the offspring. This, of course, is a matter for the future. I can only hope to point the way.

"Science long has recognized that certain animals acquire a color similar to the color of their surroundings. For example, the hair of certain rats in the deserts is sand-colored. Every one knows of the white-furred animals that inhabit the polar regions. I seek to prove that the acquisition of these colors is due to the animals' direct imitation of their surroundings. Further, I hope to prove that their bodies are altered in form and structure, and that these changes are not characteristic of the lower animals alone, but of mammals as well, and probably man.

Color Changes Inherited

"In experiments with salamanders I have shown that specimens forced to live on a yellow background eventually become almost yellow and that their progeny is yellow at birth. Likewise, salamanders that have lived on a black background become almost entirely black, and the next generation is black as well. By placing land toads on an island in a warm aquarium through which cool water was flowing, I caused them to plunge into the water to escape the heat and to acquire, in time, the characteristics of the water-dwelling toads, including pads on the feet. These characteristics have become permanent and have been transmitted to the next generation.

"Strange to say, I have noted that the acquired characteristics become stronger and of greater hereditary power than the original, or natural characteristics. Probably I can make the reason for this clear by a simple analogy. A man is more conscious of new shoes on his feet or a new ring on his finger than of old shoes or an old ring he has been wearing for years. That is because the new articles irritate.

New Qualities Gain Force

A somewhat similar sort of irritation is caused in animals by a new physical characteristic, because it is unfamiliar. And the acquired characteristic, because it is constantly making its presence evident, exerts a stronger force in propagation than the old characteristics.

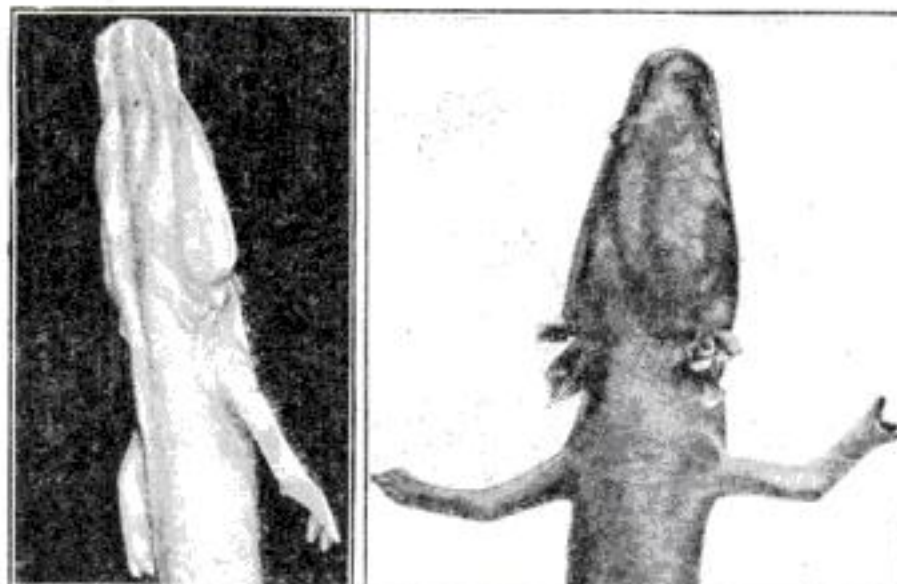
"Dr. Francis B. Sumner, of California, by placing rats in cold and warm rooms, has caused the animals to vary in the heaviness and texture of their coats. He also has performed experiments that have indicated that color changes in animals



Salamander confined on black soil, showing growth at one year intervals and pronounced tendency toward blacker color



Salamander confined on yellow soil, showing changes at one-year intervals and increasingly lighter color



These two photographs show the results of the remarkable experiment in which Doctor Kammerer claims to have grown eyes on a blind newt to prove the inheritance of acquired characteristics. At the left is the eyeless newt that inhabits dark sea depths. At the right is a newt that has grown eyes after successive generations subjected constantly to red light. The eyes have pushed through its head

are due in large measure to the animals' adaptation to their surroundings. That is to say, color changes are due not merely to the survival of those animals that in colorings are best fitted to live in their particular surroundings, but to more or less rapid acquisition by the animals of the color of their surroundings.

"These changes—in color, form, structure and traits—biologists generally hold



Doctor Kammerer at work in his laboratory, examining a rat with which he is experimenting to prove his theories

Both of the salamanders, the growth of which is pictured above, were descendants of a fire salamander confined on yellow soil during its life

come about through evolutionary changes through many generations. My contention is that the evolution is shorter; that the changed characteristics are acquired by one generation and transmitted to the next, after which they are permanent and will remain so until change of environment causes other changes.

"It is a long step from my experiments to the formulation of principles that may be applied to man. I am convinced, though, that some day we shall have well-defined laws regarding the transmission of characteristics

in the human race. We shall know how favorable characteristics may be acquired and how they may be passed on. Then the world always will be assured of leaders in the arts and sciences."

Doctor Kammerer is a slight man of 43, an ascetic in appearance. He is a musician and composer and the author of a dozen books and innumerable scientific papers; yet his revolutionary theories have met with slight encouragement from the scientists of his native land.

When he sought the right to lecture at the University of Vienna 12 years ago, the scientific paper that accompanied his application was rejected summarily, and the application denied. A little later, though, this same paper was awarded the Soemmering prize, his country's most coveted award for distinguished scientific work.

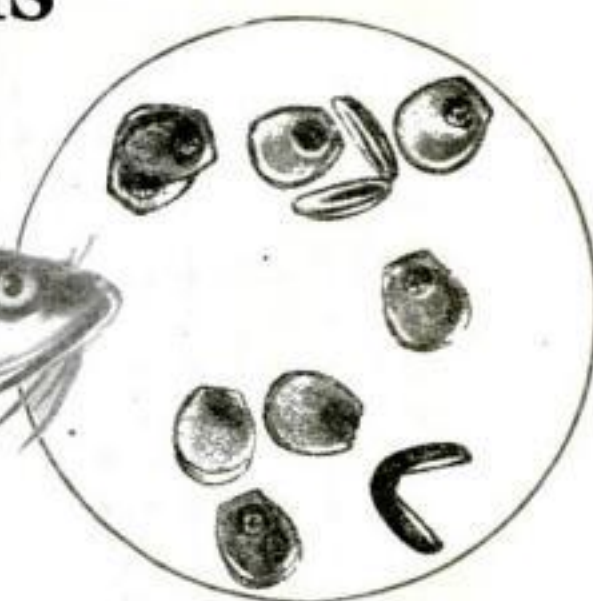
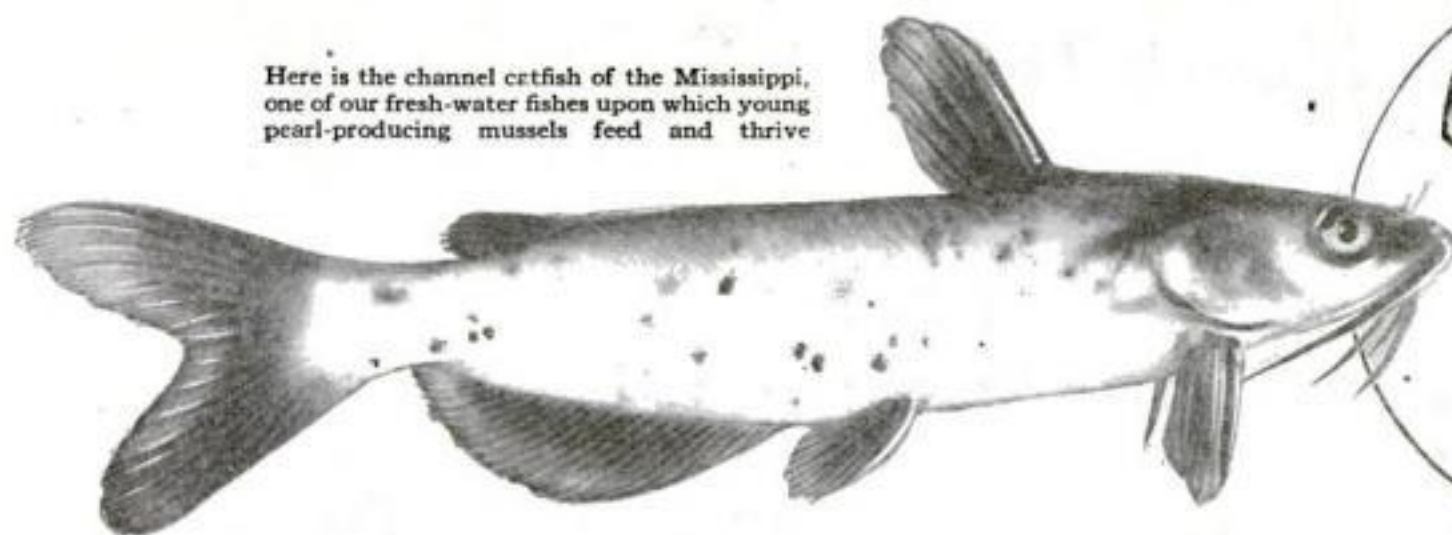
Called to English University

Then the University of Vienna sought out Doctor Kammerer, making place for him as lecturer. Yet he had to live, support his laboratory and buy biological specimens, on about \$150 a year. Then he was called to the colors.

After the war, he no longer was able to maintain a laboratory, and the pursuit of his work seemed hopeless until, about a year ago, he was invited to lecture before a group of scientists at Cambridge University, England. There the attention of the world was drawn to him, and his present visit to America is the result.

Fish Planters to Make Our Rivers Yield Fortunes in Pearls

Here is the channel catfish of the Mississippi, one of our fresh-water fishes upon which young pearl-producing mussels feed and thrive



A microscopic photograph of embryo mussels, future producers of priceless pearls, which Uncle Sam's scientists are propagating for commercial use

By Robert E. Martin

SCIENCE soon will place millions of dollars in the inland streams of the United States, there to be gathered by any one who desires.

This amazing announcement was made recently by the United States Bureau of Fisheries which, through scientific propagation of fresh-water mussels, plans to make dozens of rivers throughout the land yield rich harvests of wealth in pearls.

During the last year the streams of the country are estimated to have given up \$15,000,000 in these gems, produced by natural means within the shells of mussels that lie along the bottoms of rivers like the Mississippi, and the Black River and White River in Arkansas—streams that have been dragged by pearl fishers for years.

Science Enriches the Pearl Market

But this enormous annual wealth in fresh-water pearls is small, say government experimenters, compared with what may be expected from scientific methods of increasing pearl production—methods that will be adopted this year as the result of long experiments by the Bureau of Fisheries with 500 varieties of mussels found in the Mississippi Valley. In from four to six years they expect a crop of pearls that will surpass in treasure the richest "strikes" made in the gold-fields of California and Alaska.

The experiments of the bureau were conducted at its station at Fairview, Ia. Of the 500 varieties of mussels tested, 40 were shown to lend themselves to pearl culture. Many of these, it was found, could be stimulated to the production of larger and finer pearls. The fact that single pearls worth \$25,000 already have been produced naturally and taken from the streams of the country, gives some indication of what may be expected with scientific propagation.

The spawn of the mussel is a parasite. It attaches itself to the gills and fins of certain fish, particularly catfish and bass. Unless it can find this lodgment and feed upon the tissues of the fish, it will die. In from nine to 24 days, depending on the species, the mussel is developed sufficiently to drop away from the fish and sink to the bed of the river. There, after several years' growth, the mussel produces its valuable pearls.

The plan of the government is to procure the spawn under favorable

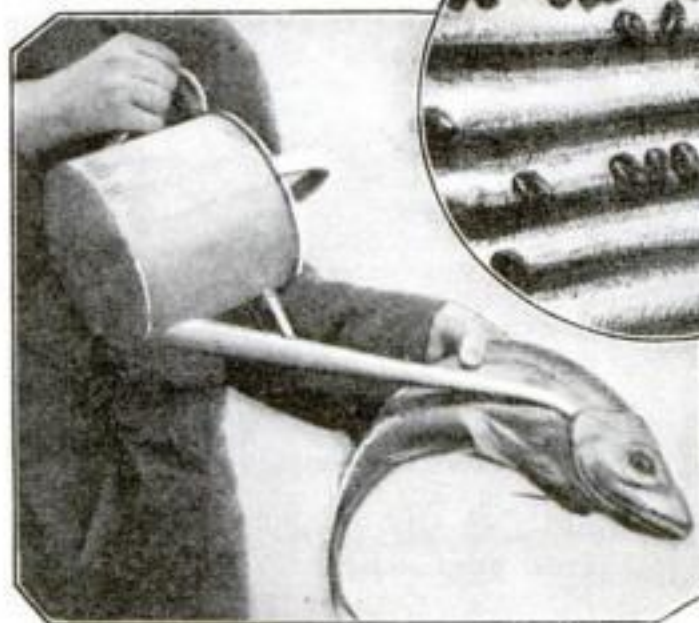
conditions and to see that the spawn has its opportunity to thrive by attaching itself to fish. This will be done by inoculating fish that are left stranded in shallow water when rivers recede after spring floods.

Salvaging these fishes by placing them back in the rivers is a work carried on extensively by the Bureau of Fisheries, millions of fish being rescued by government men every year. The method of inoculating the stranded fish with mussel spawn will be either to place them in water containing the spawn or to pour the spawn-filled water directly into the gills.

The Bureau of Fisheries already has spread mussel spawn through 350 miles of the Mississippi between Iowa and Mississippi. It is estimated that the yield of this sowing will be not less than 3,000,000 mussels, many of which in five years or so will contain pearls.

The mussels are gathered by dragging the bed of the river with blunt hooks. Then they are subjected to heat sufficient to cause the shell to open without ruining the pearls. After the mussels have been inspected for pearls, buttons and other ornaments are made from the shells, or they are ground up to serve as chicken feed and fertilizer.

The largest pearls found in United States rivers include one weighing 103 grains, taken from the Black River, Ark., in 1904, and one weighing 68 grains, from the Wisconsin shore of the Mississippi in 1907. These sold respectively for \$25,000 and \$15,000. The record catch for a month contained pearls worth \$300,000, taken by Wisconsin fishermen.



Inoculating a fish with embryo mussels. Water containing the embryos is poured into the gills. The inset shows how the young mussels attach themselves to the gills, feeding upon the tissues



Government fishermen rescuing fishes that have been stranded in land-locked sloughs along the Mississippi after the spring floods. Before they are returned to the river, these fishes will be inoculated with embryo mussels so that they may yield a great pearl harvest

Putting Plants to Work on the Night Shift

Science Speeds Up Nature's Food Factories

By Newton Burke

YEARS ago, through the development of artificial light, science made possible the 24-hour day in industry. Now, through the same agency, science is putting plants, like human workmen, on the night shift. For scientific research has revealed the fact that certain plants may be grown by electric light. Subjected to artificial light after nightfall, these plants are found to be hurried to maturity with double their normal speed and to acquire as well a vigor equal to, and possibly greater than that of plants grown under natural conditions.

Growth Is Doubled

In a six weeks' experiment conducted recently by the Westinghouse Electric and Manufacturing Co., in a greenhouse at Baldwin, N. Y., 12 varieties of flowers and 12 of vegetables were sown. Half of the plants, in addition to being exposed to the sun during the day, were bathed in the light of six 500-watt electric lamps for five hours each night.

The other half received only the light and heat of the sun, being shielded from the rays of the lamps by oilcloth curtains.

At the end of six weeks, Professor Hugh Findlay, of the Department of Agriculture, Columbia University, who was in charge of the demonstration, found that some of the plants that had been kept working night and day were about twice as far advanced in growth as those that had received only the sunlight. These were plants that bear broad leaves—a characteristic enabling them to absorb the extra light in larger proportion than plants with smaller leaves.

The experiment has been hailed as a useful, practical discovery that can be applied immediately in commercial greenhouses to make growers more independent of weather vagaries as affecting the light and heat of the sun.

Even more astounding are the experiments in scientific plant culture recently undertaken in a plant laboratory established at Yonkers, N. Y. There 30 scientific workers actually are manufacturing every climatic condition that might affect plant growth. There, too, plants are being put on the night shift, but they are



Speeding up the growth of plants under the rays of powerful electric lights during recent tests conducted by the Westinghouse Electric and Manufacturing Co., in a greenhouse at Baldwin, Long Island. Julius Heinrichs, veteran florist, who superintended the tests, is shown above measuring the plants

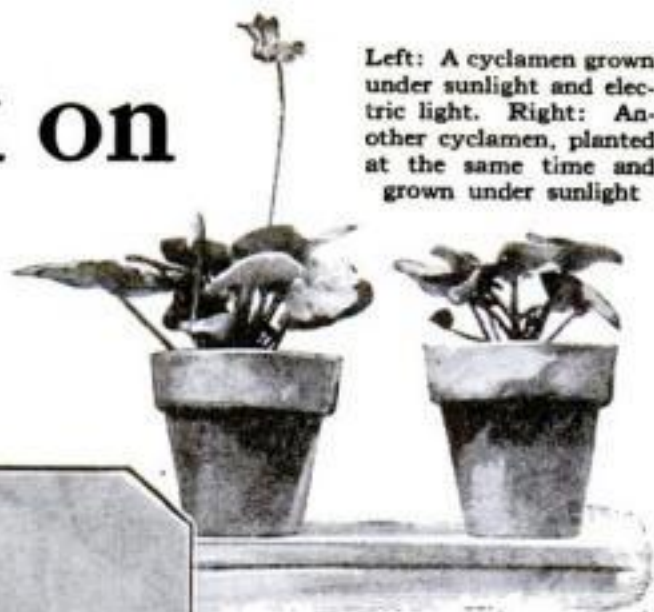
being supplied as well with tropical temperatures and with humidity as desired. Atmospheric conditions are being manufactured artificially by injecting into the air of the greenhouses the carbon dioxide that the plants require in larger quantities than nature provides.

The ultimate purpose of the Yonkers laboratory, known as the Thompson Institute for Plant Research, is to conserve and improve the food supply of the world for future generations. The institution has been established by funds pro-



By inclosing healthy aster plants in these glass cages, then introducing a different species of insect into each cage, experimenters at the Thompson Institute for Plant Research discovered that the plant disease known as "asters' yellows" is carried by the brown leaf-hopper, a very tiny insect

Left: A cyclamen grown under sunlight and electric light. Right: Another cyclamen, planted at the same time and grown under sunlight



vided by Colonel William Boyce Thompson, of Yonkers, noted mining engineer, financier, and philanthropist. Several years ago Colonel Thompson recognized an alarming possibility that the hand of famine might some day be laid on America, the land of plenty. He foresaw that within 25 years at the rate our population is growing, the farmlands of the United States, under present methods of cultivation, will be taxed to their limit of production; in other words, that the yield of the farms will be barely equal to feed the 140,000,000 or 150,000,000 people who will then be in the country.

Patriotic Research

He determined to do his share to increase the native crops of America so that this country need never be dependent on the rest of the world for food. The result was the establishment of the

Thompson Institute, which bears the same relation to the world of plants that the Rockefeller Institute for Medical Research bears to mankind.

Control of the diseases of plants and improvement in methods of cultivation, comparable with the sanitary measures by which modern science has bettered the living conditions of man and added to his span of life, have been awaiting the efforts of just such a pathfinder. The Thompson Institute will stand midway between the State and Federal agriculture experiment stations, busied with solutions of immediate practical problems, and the universities and colleges where botany departments are devoted to pure science. Its research work will be conducted always with the practical end in view of eventually bettering and increasing the food supply of the world.

The institute occupies a nine-acre plot, and comprises a quadrangle of laboratory buildings and extensive greenhouses. One laboratory building has been completed at a cost of \$700,000 and now houses 30 scientific workers. These include not only plant experts, but chemists, microscopists, bacteriologists, and specialists in other

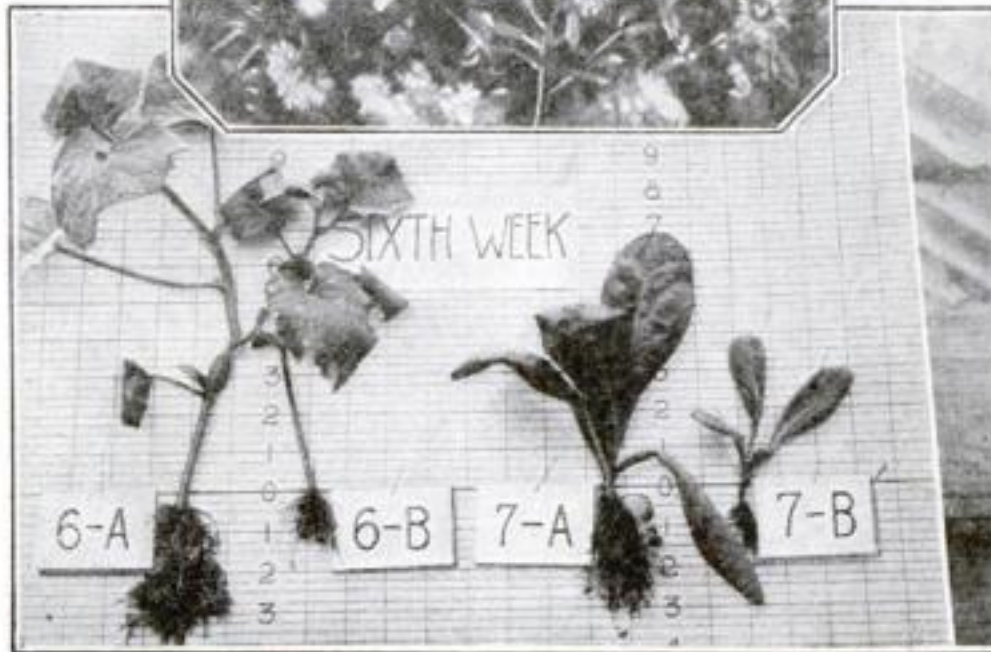
related branches of scientific research.

The laboratory equipment includes the world's most improved apparatus for plant research. Individual laboratories are provided for the experimenters, each laboratory having electric current of 110 and 220 volts, vacuum pipes, high and low steam pressure, gas, refrigeration, and compressed air as standard equipment. There are dark-rooms for photographic work, refrigerating chambers, and a microchemistry laboratory.

In one of the greenhouses "sunlight" can be maintained at night, as in the Columbia University experiment at Baldwin, by swinging a crane that supports a bank of 42 1000-watt electric lamps above the plants. But electricity, although making possible a night shift for plants, supplies only a poor imitation of sunlight; for, while the sun gives 37 per cent light and 63 per cent heat, electric light gives only 7 per cent light and 93 per cent heat. The tremendous heat generated by the lights in this greenhouse would be sufficient to bake the plants under cultivation as well as to make it impossible for any one to enter. So the heat of the lamps is "filtered" by causing their rays to pass through two glass plates between which is flowing constantly a stream of clear, cool water.

Still other greenhouses are provided with roofs of "spectrum glass"—especially colored glass that absorbs the ultra-violet and other rays of the sun detrimental to the growth of plants. Under these roofs plants have been found to develop with double their natural speed.

An investigation during the last six months to determine the carrying agent of "asters' yellows," a virus disease that attacks asters, indicates the sort of practical work the institute will carry on. Believing that this disease was transmitted by insects, Dr. L. O. Kunkel, plant



How the addition of a "night shift" with artificial light increases plant growth. The cucumber plant lettered 6-A and the lettuce plant, 7-A, were grown under both artificial light and sunlight, while the cucumber, 6-B, and the lettuce, 7-B, were grown under sunlight only. The upper picture shows Dr. William Crocker, director of the Thompson Institute for Plant Research and one of the foremost botanists in America

pathologist at the institute, constructed about 25 glass cages—greenhouses in miniature—in each of which was placed several healthy aster plants. Insects then were introduced into the cages, a different species in each. Soon it was observed that only in the cage containing specimens of the brown leaf hopper, a tiny insect not much larger than a mosquito, did the plants develop yellows. This determined the carrier of the disease. The next step will be to find the causative agent, which may or may not be a protozoan—a single cell of animal life that has its first stage of being in the insect carrier. That found, the next problem will be to produce a plant capable of resisting the disease.

It is interesting to note that the method used to determine the carrier of asters' yellows was almost identically the method employed in discovering that yellow fever was transmitted by the mosquito. In fact, there is a remarkable similarity between the diseases of plants and human diseases.

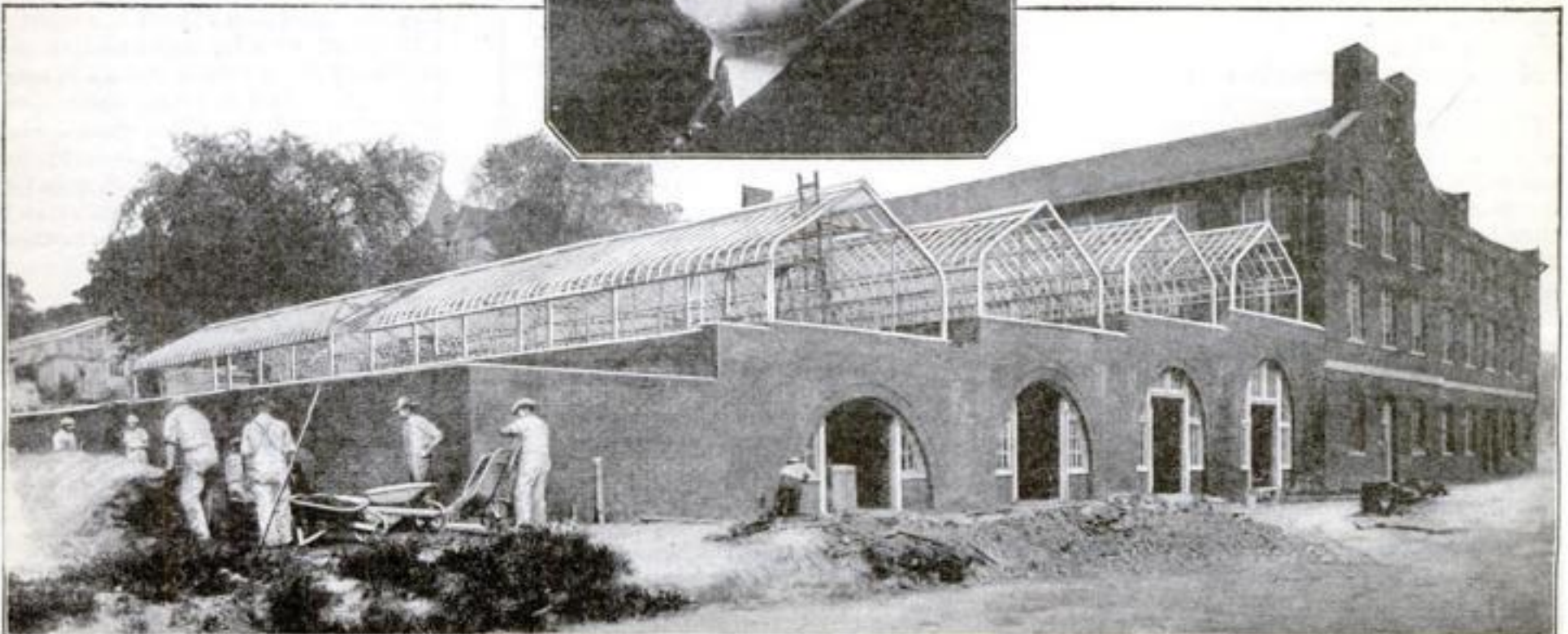
Plant research offers unlimited fascinating possibilities for food conservation.

The loss through plant diseases of a single bushel of wheat from an acre may not seem appalling at first glance; yet if a single bushel is lost from every one of the millions of acres that are

under cultivation, a tremendous blow is struck the world's food supply.

Conversely, adding one bushel of wheat to the yield of an acre may not appear to be an accomplishment of enormous importance, yet the wheat crop of Canada has been increased 20,000,000 bushels a year by this means.

It is toward this end that the energies of the scientists at the Thompson Institute are being employed. The director of the institute is William Crocker, one of America's foremost botanists, famous as the discoverer of ethylene.



The new \$700,000 building of the Thompson Institute, nearing completion at Yonkers, N. Y. Here 30 scientific workers will use the world's most improved laboratory equipment to study plant diseases and their

cure. The inset shows the founder of the institute, Colonel William Boyce Thompson, noted mining engineer, financier, and philanthropist, who is doing a patriotic work in endeavoring to increase America's food yield

My Plan for Cheaper Homes

World-Famous Inventor Offers Novel Method of Building Distinctive "Custom-Made" Dwellings of Concrete Slabs

By Simon Lake

NEARLY everybody has felt the pressure of the housing shortage that has existed in the United States for several years. At a time when this shortage was most acute, there occurred to me the possibility of developing a new type of dwelling—one that admitted of speedy construction and less costly materials, yet one that could be erected by a small number of men.

From Ships to Houses

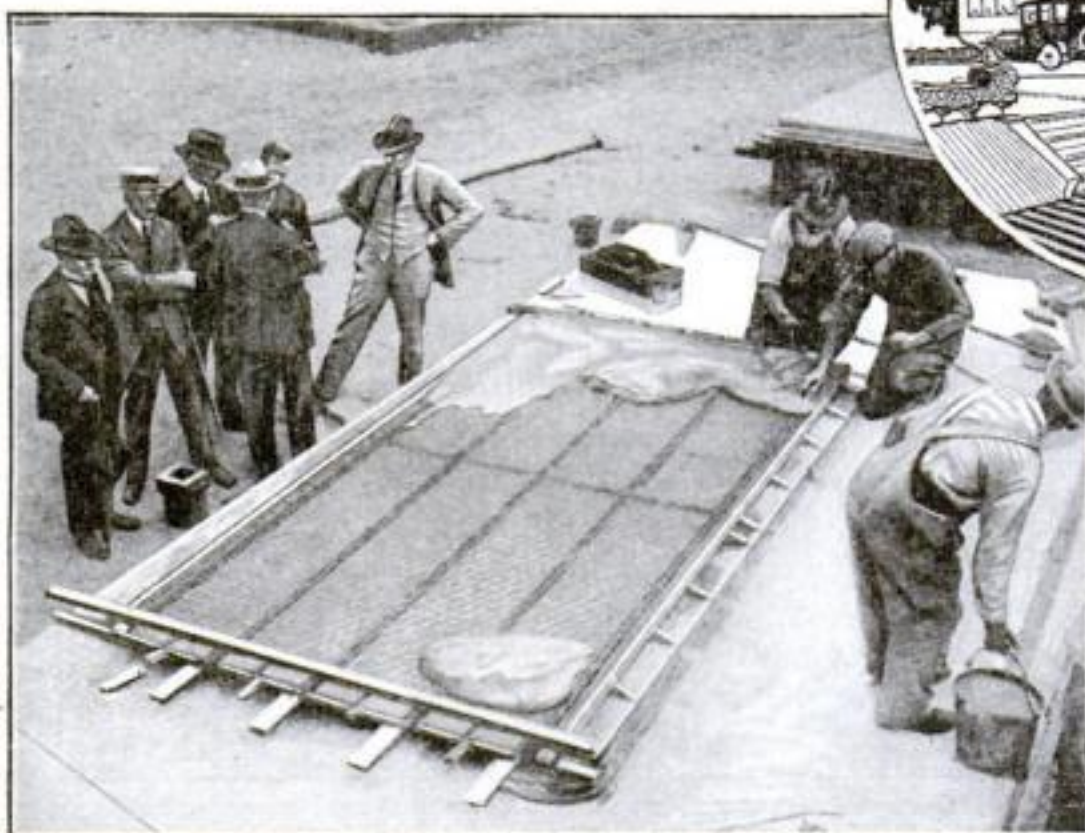
It may be remembered that during the war concrete was proposed as a substitute for lumber or steel in the construction of ships and that a number of ships were built of this material. I took out some patents for concrete ships having double walls to make them suitable for carrying grain, and it was only natural to apply this construction to houses. I built my first experimental house in 1918 and also built a number of test slabs.

Out of that experiment has come a new plan for house building based on the use of reinforced concrete slabs made in standard sizes for all parts of the house. These slabs are hollow, so that a layer of air acts as an insulator between the inner and outer surfaces; insuring coolness in summer and warmth in winter.

A Practical Concrete House

I have now completed what I believe to be an entirely practical method of manufacturing concrete houses of any type, from a small sea-shore bungalow to a skyscraper, according to any plans that may be drawn, with any sort of exterior finish or decorations that may be specified, with any sort of interior arrangement of rooms; houses that are rainproof, moisture-proof, cold-proof and heatproof, earthquake-proof, and all but indestructible. Moreover, I believe these houses can be built for approximately half the cost for which brick houses could be erected by the usual standard method of construction. Small houses of the bungalow type can be put up like Aladdin's palace, virtually overnight.

This may sound like a flight of



Casting one of the reinforced concrete slabs for a Lake-constructed house. One slab is said to be equivalent to 2000 bricks. Casting requires only a few minutes, and the slab may be used in construction on the following day after it is cast.

fancy, but I assure you it is not. Plans of construction and manufacture have been worked out scientifically. The strength of construction has been tested by municipal experts and has exceeded their requirements. Model houses have been built and have withstood a variety of drastic tests.

In this connection it may be well to mention here that a scientist investigating earthquake and fireproof construction of houses on behalf of the Japanese govern-

Homes by the Wholesale

SIMON LAKE, world-famous inventor of submarine boats, here describes a novel method he has devised of constructing distinctive houses of a wide variety of dimensions and architecture from precast concrete slabs of standardized sizes.

That building methods of the sort are considered quite practicable is shown by the amazing project recently announced by Henry Ford of erecting a whole city of 30,000 cement and wooden houses on a 5000-acre tract near the Ford plant at Dearborn. The homes Mr. Ford purposes building are to be constructed according to a plan perfected some time ago by Thomas A. Edison, which permits 12 different types of cement houses to be molded in the same set of forms.

How tremendous a job is the simultaneous construction of 30,000 homes is apparent when we realize that they would be about capable of accommodating the population of such cities as Des Moines, Ia., Albany, N. Y., Paterson, N. J., Reading, Pa., Norfolk, Va., Salt Lake City, Utah, and Spokane, Wash.



Architect's drawing of a distinctive dwelling such as Simon Lake says can be built of concrete slabs by his new process. Stone walls, slate-shingled roofs, and other exterior decorations can be produced, he says, by placing a veneer of the desired material on the slabs as they are cast.

ment recently studied my new method of house-building, indorsed it enthusiastically, and is taking the details of my process back to Tokio with him.

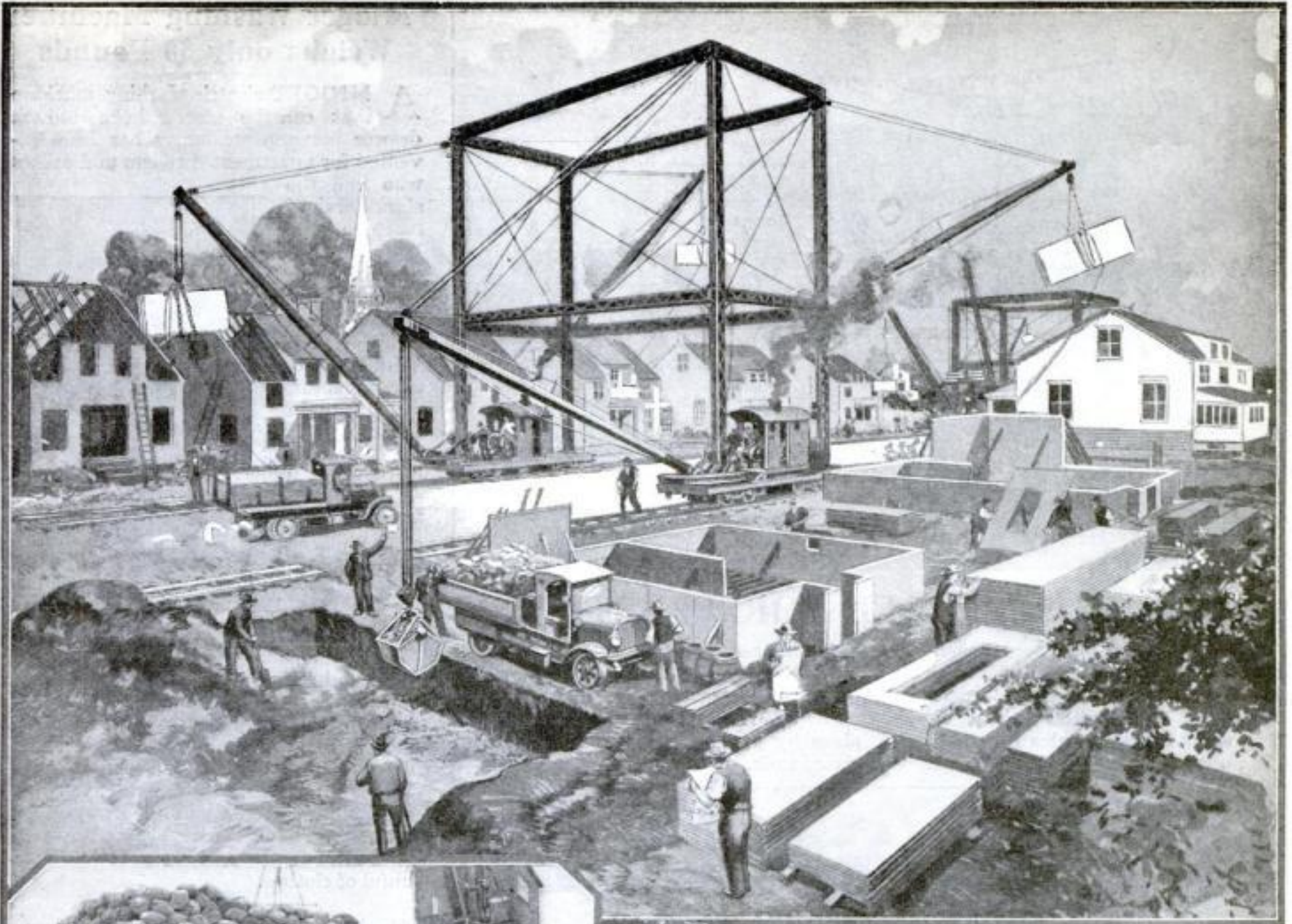
The essential difference between the new plan of construction I have evolved and my former experiments in the building of "one-piece" houses consists in the fact that, while the early houses were ready made, those that I plan to build now may be custom made. That is to say, the prospective home owner need not be limited in choice to a fixed number of "ready made" plans, but may have his house built according to his architect's plans, no matter what the style of architecture or of exterior finish.

The house may be constructed on the lines of a Dutch Colonial cottage, a modern American mansion, a square city house, or a factory building. It may have stucco walls and a tile roof, brick walls and a polychrome slate roof or a fieldstone basement with upper floors shingled. It may be painted, it may be treated to give the effect of marble, or it may remain undisguised and unadorned concrete construction.

For Decorative Effects

The distinctive decorative effects are produced by placing a "veneer" of the desired material on the surface of the slab when casting. The effect of a heavy roof of slate, for example, is obtained by installing on the slabs slate shingles only a sixteenth of an inch thick. The effects of tile, brickwork, or stone are produced similarly. Once installed, the "veneer" becomes an integral part of the slab itself.

In my plans for building custom



This drawing shows how the inventor foresees the application of his method of constructing "custom-made" slab houses to large-scale suburban development. The slabs would be transported to the development site by railway, lighter, or motor truck and carried to each house site by a traveling derrick running on tracks. In building a house the derrick also would lift the slabs into place. All excavation would be done by mechanical shovels, as shown. At the left: Testing carrying strength of the walls of a small house constructed by the Lake process. The weight on the roof is 31,000 pounds, equivalent to 765 pounds a linear foot

made houses I am making use of the well known manufacturing principle of standardized parts. The units of construction are slabs 12, 16, 20, or 24 feet in length and up to 10 feet in width. Those lengths are used because I have found them convenient and best adapted to the various types of houses. The 10-foot width was adopted because that is the maximum width of slab that may be transported safely on a flat car.

The slabs are to be cast in a central plant, carried to the location of the proposed buildings, and lifted into place by derricks. One wall slab, of the 10-by-20-foot size, which can be cast in a few minutes, is equivalent to 2000 bricks. Since the "setting" of the concrete can be speeded by a special process I have developed of circulating warm air through its hollow interior, the slabs can be installed on the second day following their casting.

That this method of construction should

the use of derricks to lift the units in place. Since by using the slabs we start with a saving of at least 50 per cent on materials, I feel confident that the efficient application of my process can result in a 50 per cent cut in the cost of a house.

Except for purely decorative features inside or out, the houses I have planned would be of slab units throughout from foundation to roof. Wooden or other flooring, if desired for decorative effect, would be laid over the concrete floor slabs. The units would be joined by a patented method, which would make the completed structure virtually one piece, effectually sealing it

be cheaper in labor cost to the unit of area than the building processes commonly employed is apparent. A further saving in this particular is effected by

against moisture and air leakage. These units also might be utilized on a steel skeleton in the construction of skyscrapers.

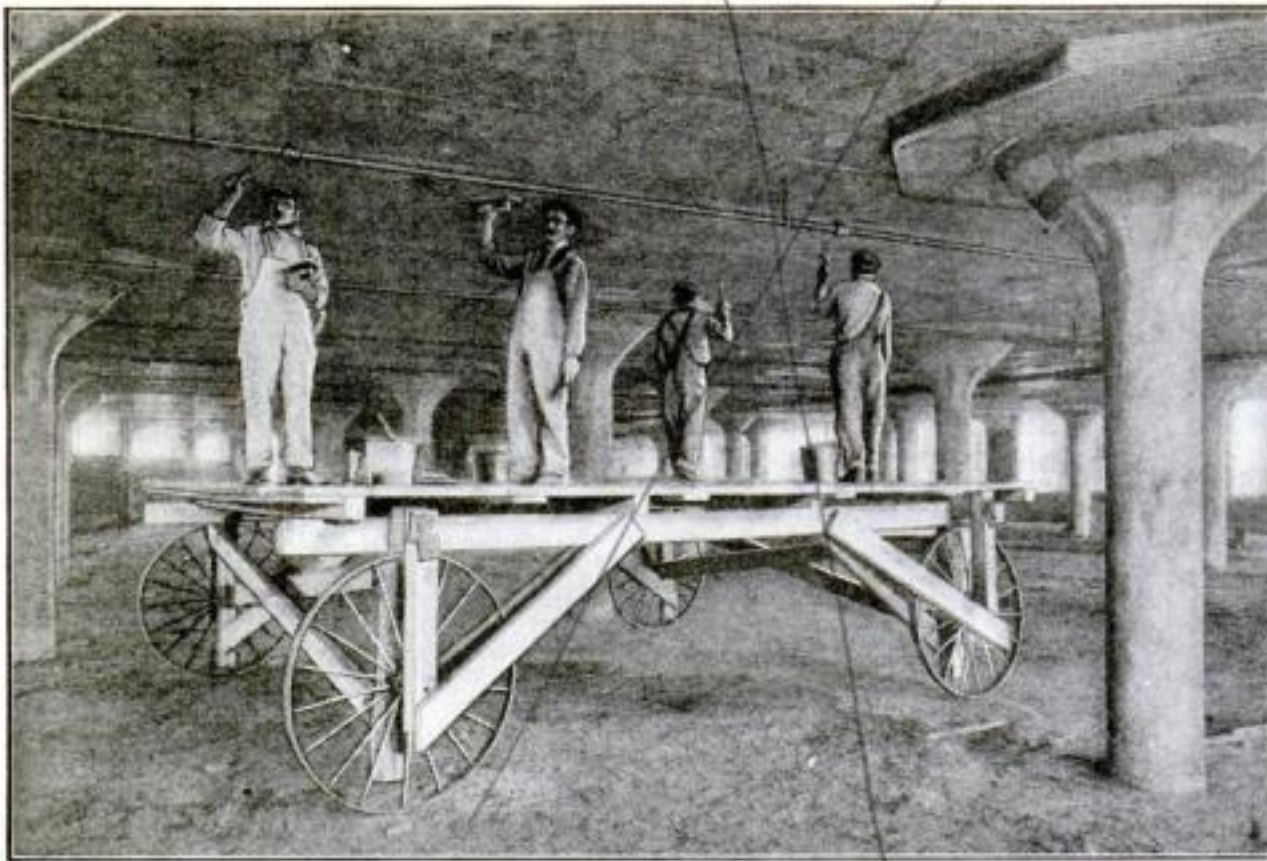
Several test houses constructed entirely on these plans have withstood shocks and jars when being transported from place to place by motor truck, greater by far than the strain put on any structure in Japan in the recent earthquake.

I have estimated that for \$3500 it will be possible to build a seven-roomed home of the type that has recently come into great popularity in suburban developments. This is much less than a good quality frame house of the same sort would cost almost anywhere in the United States.

And not only will the new process enable the home-builder to obtain a house at half the cost of other type dwellings, but also it will save him practically all cost of upkeep and repairs, assuring him of a home that should stand for many generations.



Demonstrating that the Lake-built house is earthquake-proof. The truck carrying the house has slipped into a deep rut, subjecting the building to a strain that the inventor says is greater than that exerted on any structure in the Japanese quake. The house was unharmed



A MOVING SCAFFOLD FOR PLASTERERS

THE sight of four plasterers suspending their work for an expensive period while they moved their staging, gave to a foreman for the Aberthaw Construction Co., Boston, Mass., an idea for the elimination of this waste in transportation.

On two sets of light wheels, taken from concrete buggies, he mounted a working platform, as shown above. The plasterers move this rolling platform from place to place by pushing against the wall with their hands.

Combination Bed and Easy Chair

COMBINING the functions of easy chair and bed, a newly invented folding armchair with an ingenious arrangement of fittings and compartments under the seat is designed especially for use in the small modern apartment, or for invalids.

By pressing a lever, the occupant can adjust his position to any desired angle. A bookrack, writing-table, and medicine chest keep all the more necessary comforts within easy reach. The two front legs of the chair slide forward.



How the folding chair is converted into lounging chair and bed. Pressure on a lever adjusts the back to any desired angle. Note the handy compartment beneath

SNOW MACHINE LOADS AS IT SHOVELS



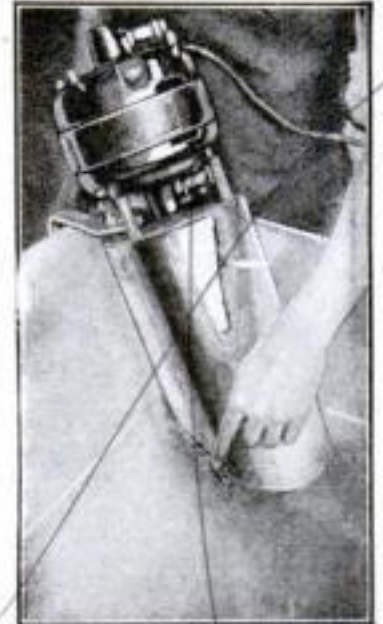
The tractor conveyor loading snow into a truck as it is shoveled.

MOUNTED on a track-laying tractor, this powerful snow conveyor and loader, perfected at Aurora, Ill., is designed to remove snow quickly from city streets. The manufacturers claim it will load a five-ton truck with eight cubic yards of snow in 2½ minutes. While a powerful shovel plunges into the drifts, the endless belt conveyor carries the snow upward to the truck.

Midget Washing Machine Weighs only 30 Pounds

A MIDGET electric washing machine that can be stored in a bureau drawer between washdays has been invented for apartment dwellers and others who find the standard sized machine too large. It is cylindrical, six inches in diameter and 22 inches long. With the electric motor, which fits in the top, it is said to weigh only 30 pounds.

The machine is placed in a corner of a tub, wash boiler, bathtub or sink filled with hot water and the soiled clothing. A four-bladed centrifugal pump in the lower part of the cylinder, into which water flows through small holes, ejects a vigorous current that swirls the clothes, cleaning them. This current has a jet pressure of five pounds to the square inch. It is claimed that 10 minutes' operation suffices to clean a tubful of clothes.



Finger points to holes through which water circulates

Spring Churns the Butter with Little Urging

SUSPENDED from a 12-inch spring, this ingenious self-operating churn is said to turn out a batch of butter in five minutes. The cylindrical container, held between two wooden strips by long thumbscrews, is hooked to the spring which, in turn, is attached to a rope tied to a convenient beam. Once set in motion, the churn needs little urging.



The churn and its ingenious spring suspension

Socket Holder Converts Vase into Lamp

ORNAMENTAL vases may be converted instantly into attractive electric lamps by the insertion of this newly invented socket attachment. Within wide limits, the fixture will fit any size vase.

Should the receptacle be desired for flowers, the attachment may be withdrawn. Trophy cups can become distinctive utilities.

Two spring clips press the inner walls of the vase so firmly that the vase-lamp



Inserting the socket attachment in vase

may be picked up by the top. No boring and no weighting with sand are necessary. The cylinder shown between the two clips is a two-pound weight that brings the center of gravity beneath the mouth of the vase, stabilizing the lamp.

Safety Stand for Smokers Won't Spill Ashes

HERE'S a smoker's stand that can't fall over or spill ashes, and that extinguishes lighted matches and stubs dropped into it. The weighted base causes the stand to return to an upright position when tipped. Anything dropped in the ash receiver falls into the hollow base, where lack of



oxygen extinguishes tobacco embers and burning matches. It is claimed also that the base retains all stale tobacco fumes.



The huge swimming pool nearing completion

World's Largest Swimming Pool 1000 Feet Long

AN \$80,000 swimming pool, said to be the largest in the world, has been completed in a 60-acre park at San Francisco in the hope that it will serve as an attraction to bring the Olympic games to America.

Measurements of the great tank are standardized for official aquatic contests. It is 1000 feet long and 100 feet wide, with the exception of a central portion 50 yards wide to provide for a racing course across the pool. At one end is a diving pit 14 feet deep. The rest of the pool ranges in depth from three to nine feet.

A 16-inch steel pipe line will bring 5000 gallons of water a minute from the



Calking seams in the concrete floor

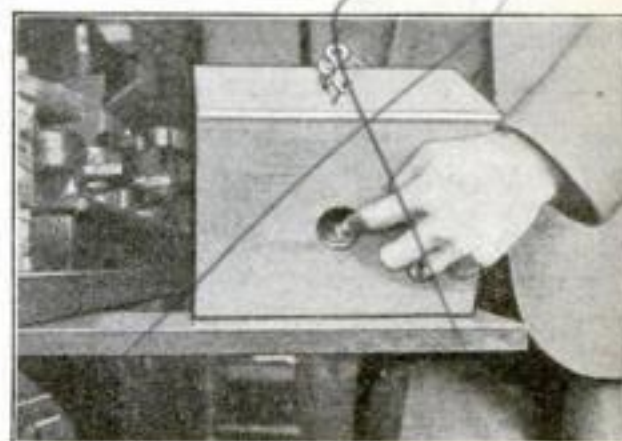
Pacific Ocean, thus keeping in constant circulation the 6,300,000 gallons in the pool, which will be emptied by gravity.

The concrete floor is formed in sections, with one-inch seams between each section, permitting the concrete to expand without cracking. To prevent the salt water from leaking through them, the seams are calked with oakum and poured with plastic asphaltic cement.

This Strong Box Sounds Burglar Alarm

THE burglar who lifts this steel strong box will be surprised. Immediately a loud electric bell will start clanging and the racket won't stop even if the box is replaced in its original position.

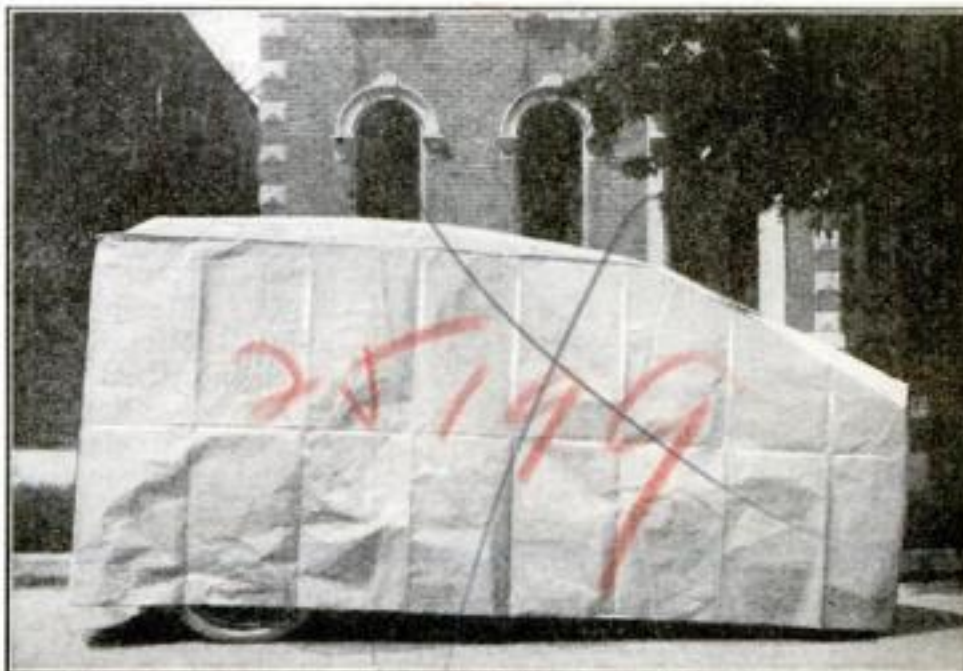
A lever inside is thrown to set the alarm. A metal pin, capable of oscillation, projects from the bottom of the box, as shown in the illustration. When the alarm is set and the box is resting on a table or in a drawer, this pin presses against the supporting surface. The slightest disturbance of the box causes



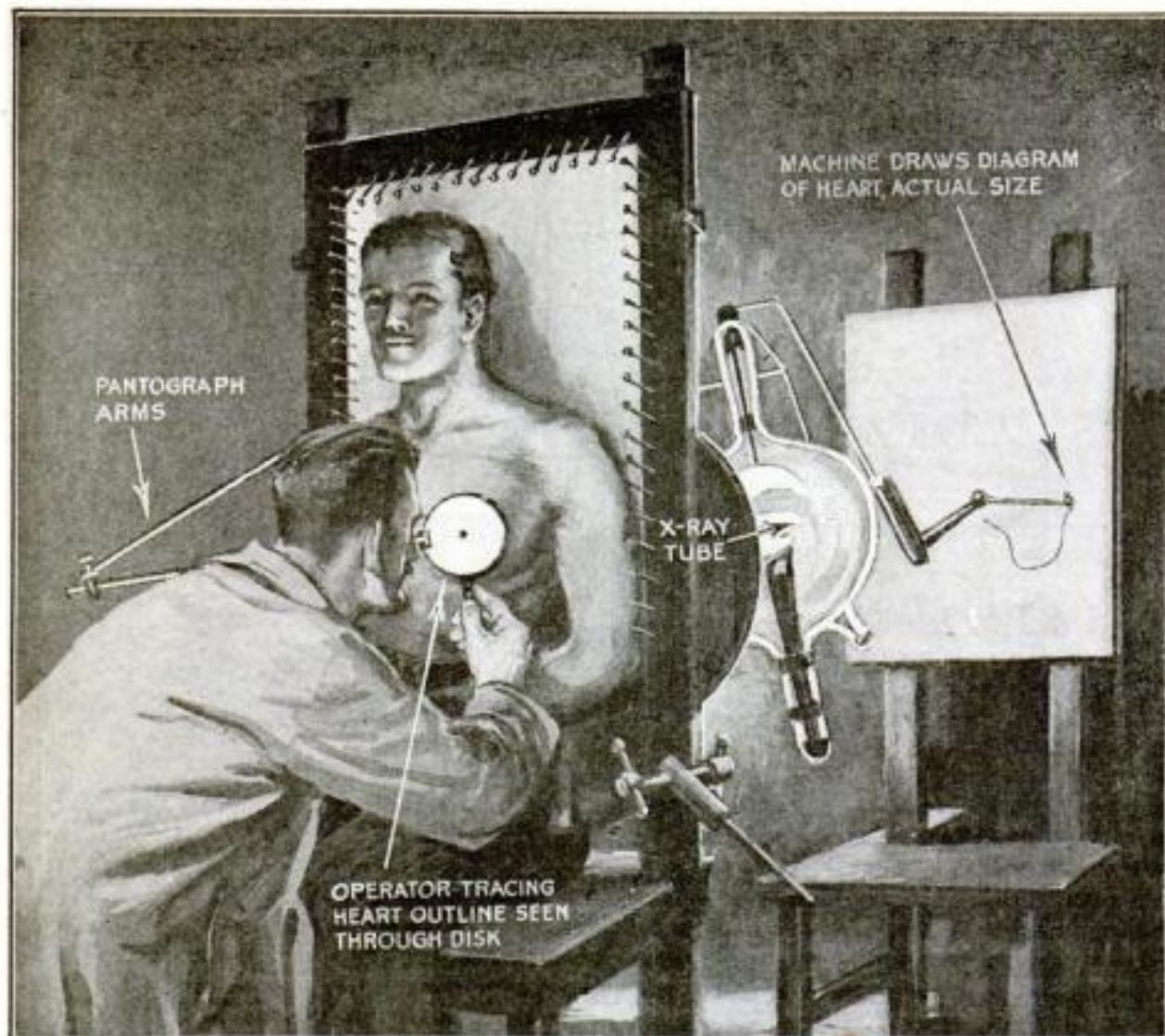
the pin to close an electric circuit that actuates the bell alarm, which rings until the spring is unwound.

PAPER COVER PROTECTS AUTOMOBILE

TO PROTECT motor cars stored for the winter, shielding them from the fine dirt and dust that injure the finish, this easily adjusted cover of strong, heavy paper has been introduced by a manufacturing concern in Shelbyville, Ind. The covers are made in various sizes to fit standard cars, and are designed to serve both the individual owner or the dealer.



This paper auto cover can be folded into a small, compact bundle



HUMAN HEART MEASURED BY X-RAYS

PRECISE measurement of the human heart is said to have been made possible by this X-ray pantograph apparatus in use at the British National Hospital for Diseases of the Heart. It is called the "orthodiagraph."

As the X-rays reveal to the operator the outline of the heart through an observation disk, he traces the outline with an indicator. To the indicator is attached the arm of a pantograph, which draws a diagram of the heart, actual size.

Portable Swing Lifts and Moves Patients

INVALIDS may be moved in comfort by this simple device. A canvas seat is placed beneath the patient, who is raised in a sitting position on the bed. Attached to the ends of the seat are two sprocket chains running through supporting arms to sprockets turned by a hand crank. By turning the crank, the attendant lifts the patient from the bed. The apparatus moves on casters.

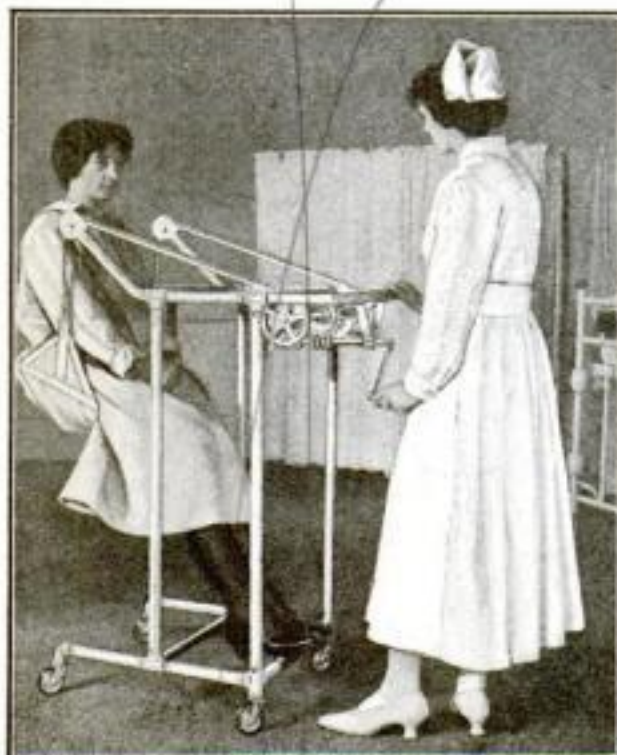


Tension Wheels Cut from Solid Steel Disks

A NEW type of tension wheel for automobiles, smart in appearance and said to possess advantages over the common wire wheel, is popular in Europe.

The wheel of lattice construction is made of two members stamped from solid disks of an especially light steel. Thus, tightening of individual nipples to adjust the tension of spokes is obviated. Since the wheel is made of two stamped disks, the tension naturally is distributed evenly. It is claimed that because of the special steel construction, it is stronger, lighter, and more resilient than other types.

WATER-GLASS, mixed with boiling water to the consistency of syrup, can be used effectively as a cleanser for clothes, discolored dishes, marble, or enamel ware.



Turning a crank lifts the patient

This Handy Tool Sharpens Razors or Knives

A SIMPLE implement for sharpening razors and knives, devised by Rockwell A. Loomis, of Guatemala, consists of a tubular handle with a threaded socket in which are inserted the shanks of jaw members. Each jaw holds a sharpening stone.



The blade of the knife or razor is inserted in a V-shaped opening between the jaws and drawn across the stones. The abrasive stones are detachably mounted so that coarse or fine stones may be used.

Useful Garage Truck

THIS handy truck, built low so heavy objects need little lifting, and fitted with rugged ball-bearing wheels, is designed to save time and muscle in the auto-repair shop.



Moving an auto engine

Grocer Candles a Dozen Eggs at a Time

"CANDLING," the process by which light is made to reveal the devastation wrought by an egg's age, recently was made conveniently available to his housewife patrons by an enterprising grocer.

His device, an observation chamber built of old boxes and containing an electric light, bares all egg secrets.



Testing a dozen eggs at once

RUNABOUT ELECTRIC CRANE SPEEDS UP FACTORY WORK

BASED on an entirely new principle, an unusual type of "runabout" electric crane recently has been introduced into British factories and engineering works. It derricks, hoists, and travels under its own power, and it can penetrate into any corner of a manufacturing plant inaccessible to a fixed crane installation.

The machine might be compared with a giant hand, ever ready to do heavy work, such as lifting a heavy casting on to a lathe, or taking steel forgings from a furnace to the machine.

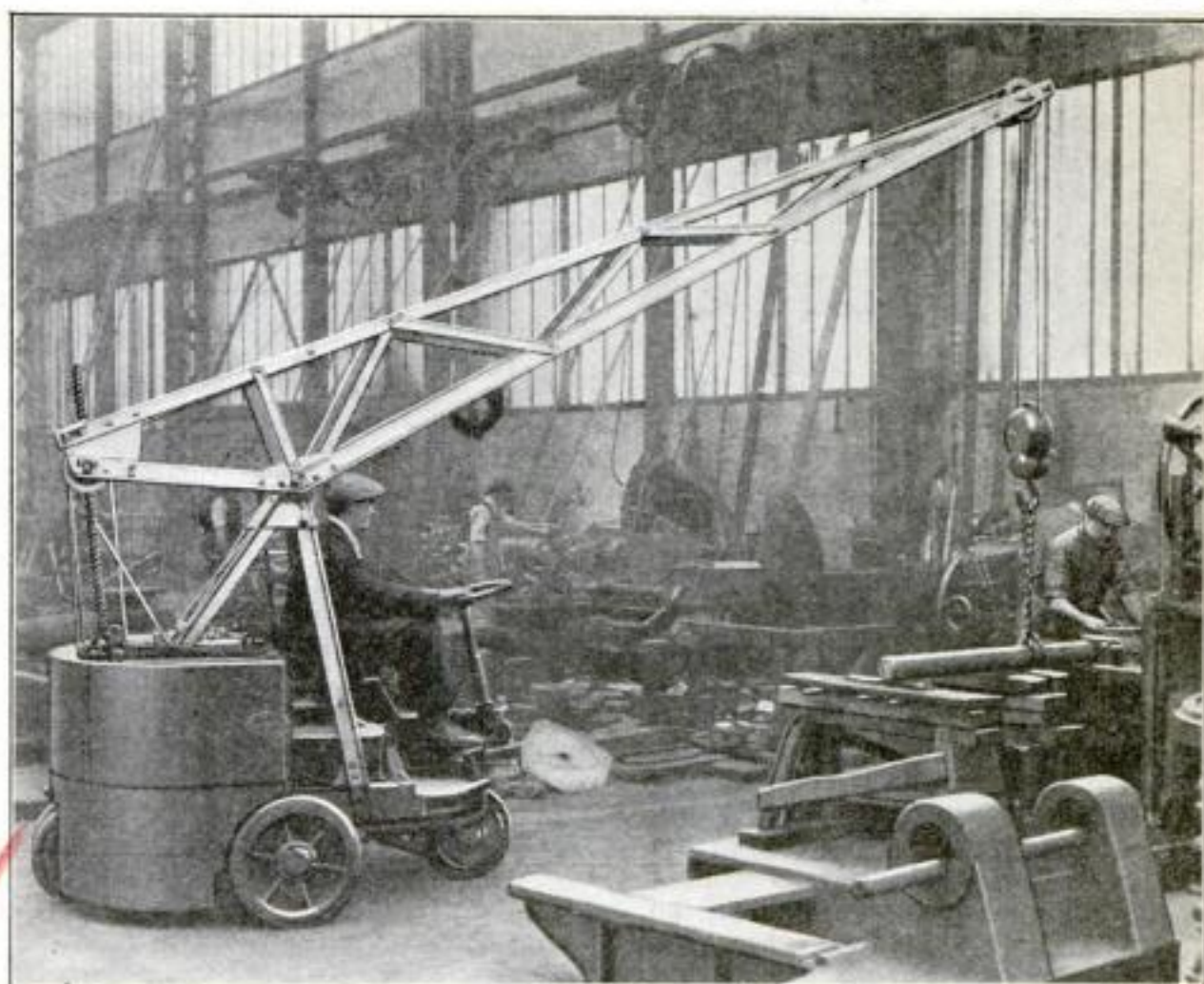
Crane Carries Own Power Unit

Cranes usually used for such purposes have long wheel bases, and consequently are clumsy and difficult to handle. These difficulties have been overcome in the new crane by combining lifting gear and chassis in a compact unit. The crane is supported by four pairs of wheels. The front and back wheels serve for steering, while two pairs of side wheels are for turning the crane. These side wheels do not swivel. They are driven by electric motors suspended from the chassis, acting through a reduction gear.

When turning, the motors are connected in such a manner that they turn in opposite directions; so that the crane turns on the spot about its own axis.

For turning, the front and rear wheels are placed at right angles to the side wheels.

The hoisting and derricking operations are accomplished by a single motor driv-



This traveling crane can penetrate into factory corners inaccessible to a fixed crane

ing rope barrels through spur-and-worm gearing. A new brake mechanism is fitted to the clutches through which the lifting gear is driven. When the clutch is being withdrawn, the brake is applied gradually from the start, and vice versa when clutch-

ing in. This is said to save a great deal of current. In addition, the motor is automatically stopped or started when the clutch lever is operated.

Current is supplied by a storage battery that also acts as a balance weight.

HOW MUCH SCIENCE DO YOU KNOW?

EACH of the 12 important scientific facts embodied in the answers to the questions asked below may come in handy for you some day.

You may be the only one in a group to know one or more of them, when the questions are raised. A sure and ready answer will bring you the respect always accorded the man who knows, the man who understands the principles that underlie and animate the world about him.

Or you may have occasion to put some of them to highly practical use. Understanding the principle of the fireless

cooker, for example, might enable you to improvise one on a camping trip.

These "Monthly Dozens" that appear in each issue of **POPULAR SCIENCE MONTHLY** are an easy and fascinating course in science, a course with the zest of a game. Test your knowledge of science with these questions. When you've done your best, turn to page 150 for the correct answers.

You'll be surprised at the amount of real satisfaction and practical value you will gain from this knowledge of the simple facts of science.

1. What is the difference between coal and diamonds?
2. Why does the bleeding from a cut soon stop?
3. Why does food continue to cook after being placed in a fireless cooker?
4. Can the songs of birds be written down as we write other music?
5. Why is it cooler on a mountain top, though the sun is closer?
6. Is it true that a drowning person always comes up three times?
7. What is the safest stimulant?
8. What is the speed of thought?
9. Why is the water of the sea salty?
10. How can you make air hot without applying heat to it?
11. How does the phonograph reproduce sound?
12. How do fireflies produce their light?

Smoker's Reading Lamp Has Ashtray Attached

FOR the man who likes to smoke while he reads, this combination ash receiver, cigar rest, and match receptacle is attached to the base of a portable reading lamp that will clamp on a table edge, a chair arm, or almost any convenient rest.

The device also is adapted for card playing, for the lamp when clamped requires only a few inches of table surface and the ashtray is below the table level.



Lamp and ashtray attached to table



Harvester Tops, Digs, and Loads Vegetables

TOPPING, digging, and loading beets economically and rapidly, this ingenious farming machine, invented by Joseph Wolny of Sheridan, Wyo., is said to do work that formerly required the labor of from 20 to 25 men. Its performances promise a wide utility in the great sugar-beet fields of the United States. The machine is said to be effective also in handling other root vegetables, such as carrots and turnips.

Four revolving knives and one stationary knife, the latter fastened into two flowing guides, constitute the topping mechanism that is adjustable to any height. A plowlike arrangement digs



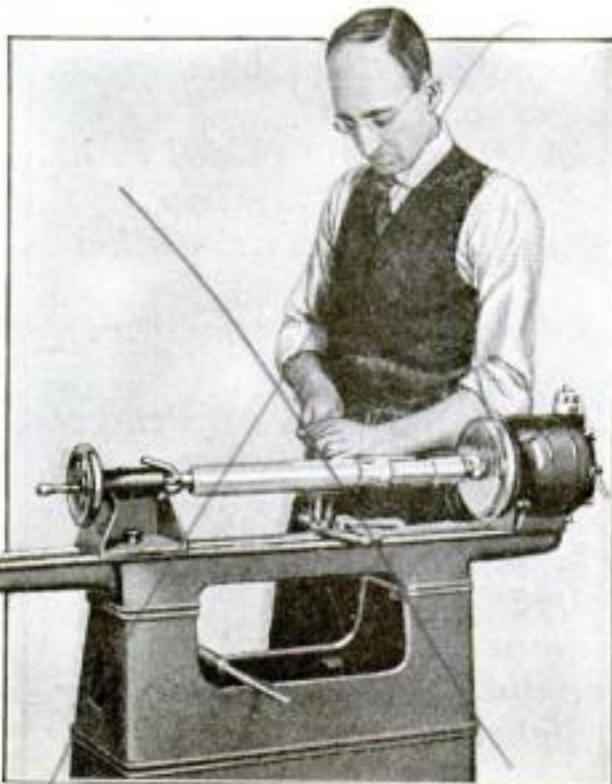
Rear view of the vegetable harvester, showing how beets are dumped from loaded container

the beets and a conveyor carries them to a box at the rear. When this box is full, the operator pushes a lever and the contents are dumped in a pile.

Smallest Motor-Driven Woodworking Lathe

A NEW single-speed bench lathe, said to be the smallest woodworking lathe with motor-driven headstock, is being manufactured for the smaller turning operations that make up the bulk of the work in nearly all woodworking shops.

The lathe is intended for work up to six inches in diameter and operates at 3400 revolutions a minute. It weighs but 203 pounds and can be moved with fair ease. It is 46 inches high and 40 inches long. The sub-base is open, serving as a holder for tools. An entirely inclosed one-third-horsepower motor drives it.



The midget lathe, showing headstock motor

Mechanical Servant Cuts and Cores Oranges

CUTTING and coring oranges or grapefruit quickly and attractively, this light, handy new machine is designed especially for the housewife who takes pride in equipping her kitchen with time- and labor-saving mechanical servants. It is claimed to work with five times the speed of hands.

A pair of curved blades is arranged ingeniously to give an up and down as well as a circular motion. The fruit is held just beneath the blades in a cup that forces it upward.

The machine may be clamped easily to the edge of a table.

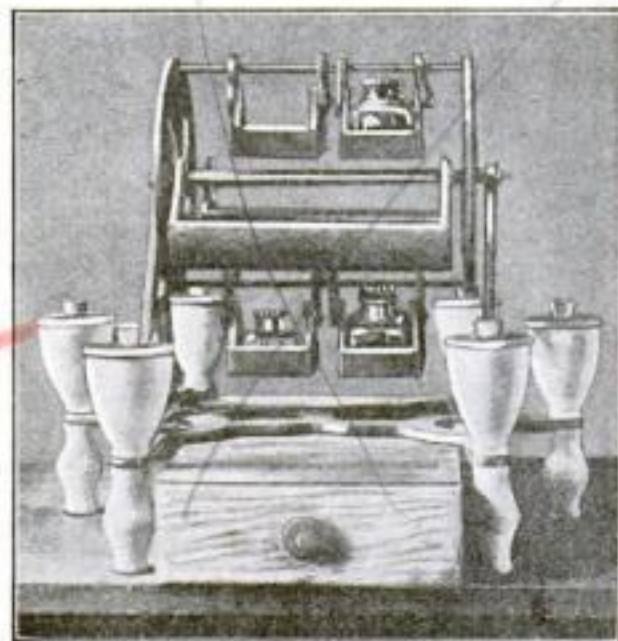
This Handy Tool Combines Wrench and Pliers

COMBIN-ING a pair of pliers with a monkey wrench that can be adjusted instantly without turning the usual knurled wheel, this unique tool has been designed especially for home use.

When used as a wrench, the jaws are adjusted to the object they are to clamp and the toothed tip of the pliers handle is engaged in one of the depressions of the corrugated strip beneath the lower jaw. This holds the jaws firmly in place.



Desk "Ferris Wheel" Holds Pencils, Pens, and Ink



SERVING as a compact and handy container for office materials, the Ferris wheel device shown above has been designed to save time and annoyance for the business man.

Extending between the two wheels are four bars, each suspending two ink bottles in two holders. Two troughs, one on each of two other bars, hold pens and pencils. These, like the Ferris wheel cars, cannot tip.

At the base of the device are six covered cups that serve as containers for pen points, pins, paper clips, and similar small articles.

A drawer seven inches wide, two inches deep, and 15 inches long receives papers. The wheel is so balanced that it will remain stationary in whatever position it is placed.

"Tin Hats" Worn by Miners

ARMY "tin hats," designed to turn shrapnel in battles of the World War, are now being used as head protection against rock and ore in mines of California, West Virginia, and Oklahoma.



A Rapid Envelope Sealer for Office Use

THIS small but efficient envelope sealer is designed for use in offices where a more expensive device is not advisable. It is but a trifle larger than a fountain pen.

The handle contains enough water for sealing 1000 envelopes. Attached to the handle is a pan containing a felt pad that moistens the glue on the envelope flap as the sealer is drawn along it. A presser foot, immediately behind the pad pan, presses down and seals the flap.

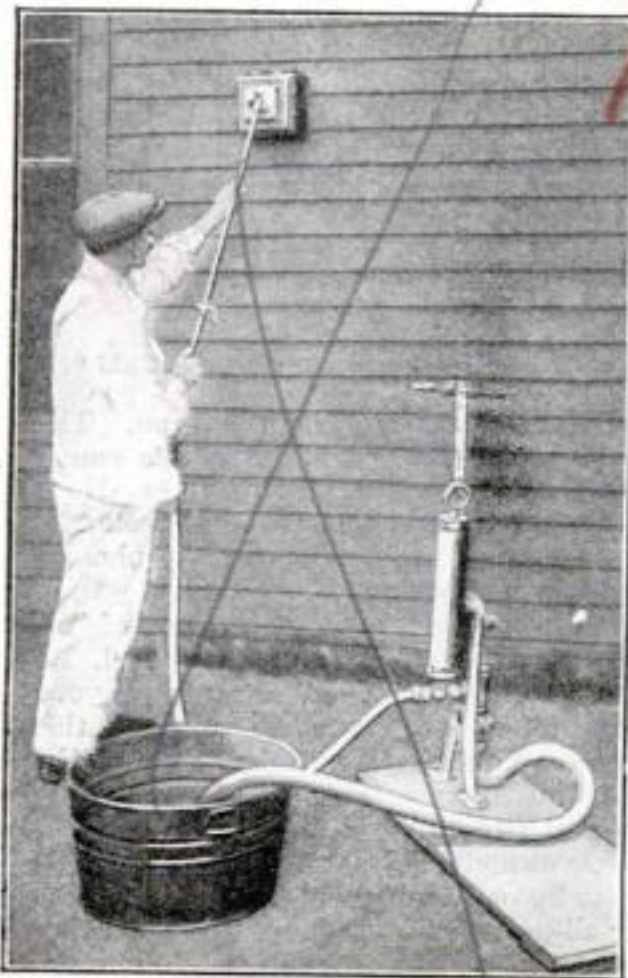
It is claimed that 60 envelopes a minute can be sealed with the device.

Guard Attachment Aids in Spraying Paint

PROTECTION of machinery, stock, windows, and other surroundings while adjacent surfaces are being sprayed with calcimine, whitewash or similar paints, is said to be possible through the use of a newly perfected guard attachment for the paint sprayer.

This guard, it is claimed, makes the spraying machine a superior tool for painting walls and flat surfaces, or for oiling large floor spaces.

The swing joint and nozzle work independently of the guard, and the nozzle may be focused at any angle. This permits of spraying trees and shrubbery.



The paint spray with guard attachment

MOVE TOWN TO BUILD A RESERVOIR

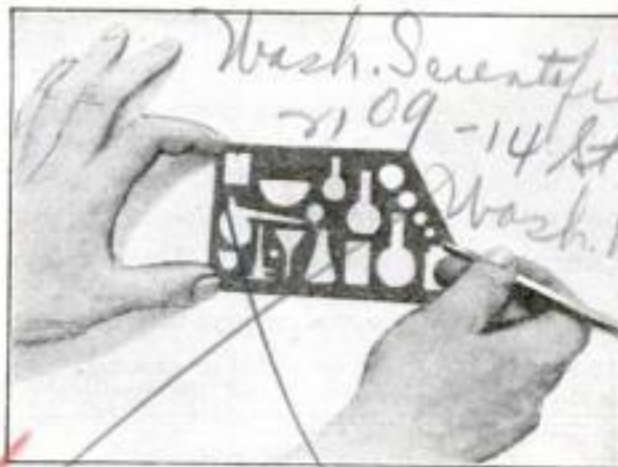
THE entire town of American Falls, on the Snake River, Idaho, is to be moved by United States government engineers in the course of building what is to be the largest reservoir in the country; for the projected stor-



Above: View of the Snake River, near American Falls, Idaho, which will supply water for the huge reservoir. At the left: Part of the town of American Falls which will be moved to make way for the government project. When the reservoir is completed, 83,000 acres will be inundated.

age basin will cover deeply the present site of the town. Eighty-three thousand acres surrounding the town are to be inundated when the project is completed.

This gigantic reservoir will have a capacity of 1,500,000 acre-feet of water, and will involve an expenditure at present estimated at more than \$12,000,000.



Mechanical Page Turner for Armless Readers

THE difficulties experienced by armless persons in turning the leaves of books or magazines and in holding down the pages have been overcome to a large extent by a simple mechanical finger with a rubber tip.

Holding one end of the device between his teeth, the armless reader manipulates it so that the tip gains purchase at one corner of the page. When used to hold the page, the instrument rests on the tip and the two legs.

Chemical Drawings Made Easy by Templet

TO AID scientists, students, and draftsmen to produce neater and more accurate drawings in which chemical apparatus appears, this novel celluloid templet or drawing guide has been devised. The figures are punched through.

Using this templet, one inexperienced man can make a hundred diagrams while an artist working freehand is completing one or two.

Typewriter Records Voice

IMPROVING on the dictation phonograph commonly used in business offices, Martin Bandli, a Swiss inventor, claims to have perfected a machine that will typewrite direct from the spoken word, thus doing away with the necessity of first dictating to a phonograph and then passing the record on to a typist for transcription.

A speed of from 90 to 100 words a minute—about as fast as the average man can dictate—is claimed for the new machine, which is operated electrically.



Turning a page with rubber-tipped finger

How to Kill Your Radio Troubles

And Silence the Howling Demons of Noise

By Jack Binns

America's Foremost Writer on Radio

CLICKETY-CLACK, Rat-tat-tat-tat, bing, bang, E-e-e-yow-e-e, crack! This is not a sample of the new type of jazz orchestra, but merely a weak imitation of what a radio receiver can do when it rears up on its hind legs and "tells the world."

There are two types of troubles that can be experienced with a receiver that is not working properly. The first is the presence of a whole orchestra of noise demons. The second is the total absence of sounds or noises of any kind.

With the possible exception of the demon static, there is no reason why a properly made receiver should not function properly without noise or trouble, giving clear, distortionless signals from stations within its receiving range.

The Commonest Troubles

What, then, are the exact causes of the varieties of trouble that bring grief to almost every radio fan at some stage of the game? First, let's see if we can't put our fingers on the most common of the trouble-makers, determine their locations, and expose the secrets of their noise-making. Afterward, we'll discuss the means of guarding against them in designing and constructing our receivers.

All trouble usually can be traced to defective parts, poor construction, or unskilful operation.

If you get crackling noises, the first thing to do is to determine whether they are caused by static or by the set. This can be done easily by listening in with aerial and ground disconnected. If that eliminates or cuts down the crackling noises, the trouble is due to static. If the noise persists with aerial and ground disconnected, you may absolve the static imp from all blame.

Many of the irregular crackling noises in a receiver are due to run-down batteries, poor wiring connections, and defective rheostats and condensers.

A steady, regular, staccato beat note, somewhat like the steady patter of a machine-gun, often can be traced to an

improper value of the grid leak. The remedy is to try grid leaks of different values till the right one is obtained.

A steady humming noise usually is caused by near-by power lines or lighting circuits near the aerial or lead-in wire. The remedy is to erect your aerial as far as possible from such lines and as nearly as possible at right angles to them.

A loose connection or open circuit in the grid circuit of the detector stage often will cause a sharp drumming noise that can be eliminated by checking up the grid circuit connections.

Whistling or howling noises may be due



Fig. 5. To assure good contact springs of the tube socket and tube prongs, bend up the springs as shown above

Every Noise Has a Meaning

THIS chart will help you locate your radio troubles, if you use the noises you hear as a guide. Tack it up for handy reference.

NOISE

Crackling

Whistling,
howling

Sharp
Drumming

Machine-gun beat
Steady humming

No noise at all

TROUBLE

Static, run-down batteries, poor wiring connections, or defective rheostats and condensers.

Too much regeneration, too many turns in tickler coil winding, poorly designed transformers, transformers too close together, parallel wiring, body capacity, overloading of tubes.

Loose connection or open circuit in the grid circuit of the detector stage.

Incorrect value of the grid leak.

Usually caused by near-by power lines or lighting circuits near the aerial or lead-in wire.

Poor aerial or ground.

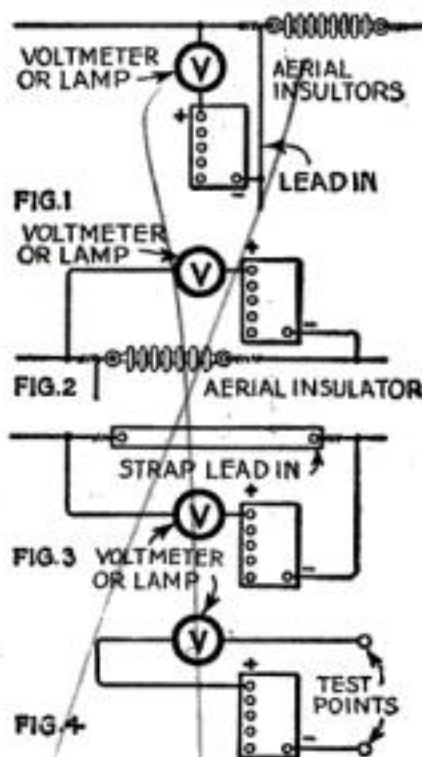


Fig. 1. How to test for open circuit between aerial and lead-in

Fig. 2. Test for short circuit between aerial and aerial support wires

Fig. 3. Test for open circuit in strap lead-in

Fig. 4. Voltmeter and battery test circuit, with testing points

to too much regeneration, too many turns in the tickler-coil winding, poorly designed transformers, location of transformers too close to each other, improper routing of wires so that grid and plate wires run closely parallel to each other, body capacity effects when the hand is brought near the controls, neglect to use a fixed condenser across the primary winding of the first stage transformer, and overloading of tubes.

The remedy for most of these troubles is obvious. Capacity effects practically can be eliminated by making sure that the rotary plates of tuning condensers are connected with the grounded or battery sides of the circuits in which they are used. Another

source of capacity effects is the method used by some makers of variocouplers or variometers to lead out the connections from the rotor windings.

A lead from the rotor winding never should be soldered or otherwise fastened to the shaft of the rotor. Flexible wires should be connected with the ends of the windings and the free ends connected with the outside binding posts or connections. Where a hollow tube is used as the shaft, these flexible wires can be run from the inside of the rotor, through the hole in the tube, and out through the end of the tube to the binding posts or outside connections.

A whistling noise changing in pitch without any adjustment of the receiver is caused by a neighbor tuning in his single-circuit regenerative set, with the circuit in an oscillating condition. The only remedy is to find out who operates the troublesome set and convince him that he should use a double-circuit set or tune in his present set with the tube filament turned down as low as possible.

When You Hear No Sounds

Don't let noises discourage you. The fan who gets noises at least gets something, even though it is unwelcome. He is better off than the fan who expectantly turns on the juice, plugs in the phones, and hears—nothing.

One of the most common causes of "no noise at all" is a poor aerial or ground. Be sure before you make any changes in your set that the trouble is not due to this cause. You can do so by making the tests illustrated in Figs. 1, 2, and 3, using the test circuit shown in Fig. 4.

A voltmeter with graduations reading up to 30 or 35 volts will be found suitable for all purposes in testing. In connecting the voltmeter in the circuit, make sure the positive pole of the meter is connected



The Radio Imps'll Get You if You Don't Watch Out

HERE are the noise imps of radio—the whole orchestra of howling, squealing, whistling, crackling, pounding demons that play havoc with radio reception, spoil the fun, and ruin your temper unless you can track them to their lair and silence them.

Greatest bugaboo of them all is static, the unconquered, who grinds his crackler in your ears while he laughs in your face.

The home of the whistlers, squealers, and howlers

is to be found in tuning elements and transformers of poor design, in faulty wiring or unskilful operation.

Other cracklers usually are found hiding in run-down batteries, poor wiring connections, defective rheostats and condensers, or in dust between condenser plates.

The machine-gunners of the crew have their headquarters in the incorrect grid leak, while the anvil chorus of the blacksmiths comes from dust in the condensers and from weak batteries.

with the positive pole of the battery by touching the free end of the meter with the negative terminal of the battery. If you get a reading, the meter is connected properly. If you do not, reverse the connections to the meter so that you get a reading when the free end of the meter is connected with the negative of the battery.

Testing for Ground Connection

To insure a good ground connection, you can make a temporary connection to another ground and then insert your test circuit between your regular ground and the temporary ground. If you get a reading, the ground connection is all right. Another way is to test around the ground clamp and see that the ground wire is making a good contact through the clamp with the ground.

Many fans, especially beginners, often forget to connect aerial and ground when testing.

A common source of trouble is poor contact of tube prongs with socket springs. Before connecting the sockets with the set, the springs should be bent up as shown in Fig. 5. A wise precaution is to bend up these springs every so often and clean off the ends of the tube prongs with a fine file, so that they will make a good contact with the springs.

Another source of trouble in tube sockets is loose binding-post connections with contact springs. Screws and binding posts always should be tightened before the socket is connected with the circuit.

So much for those who are experiencing difficulty with receivers already constructed.

Forestall Trouble Later On

In radio an ounce of prevention is worth more than a pound of cure. Testing the parts before connecting them may take time, but it will save you more time, temper, and embarrassment later on. A few simple tests often will prevent any possibility of trouble after the set is built and ready to operate.

First of all, test your batteries. This can be done easily in the manner illustrated in Fig. 4, by touching the two test points together. If a 22½-volt B battery gives a reading of less than 15 volts, throw it away and get a new one.

Coils can be tested by connecting one end of the coil with one test point of the test circuit, as shown in Fig. 4, and the other end of the coil with the other test point of the circuit. The voltmeter should show a steady reading. Where the coils of transformers are being tested, a lower reading will be obtained because of the resistance of the coil. The important thing, however, is a steady reading.

All coils of variocouplers, variometers, and transformers should be tested in the manner described above and as shown in Fig. 6. Each coil of every transformer should be tested separately. The primary-coil terminals usually are marked P and B, and the secondary-coil terminals are marked G and F.

Another test, to determine

whether there is any connection between the two coils, is to touch one test point to one terminal of the primary coil and the other test point to one terminal of the secondary coil. To make sure that the windings are not connected with the core of the transformer, one test point should

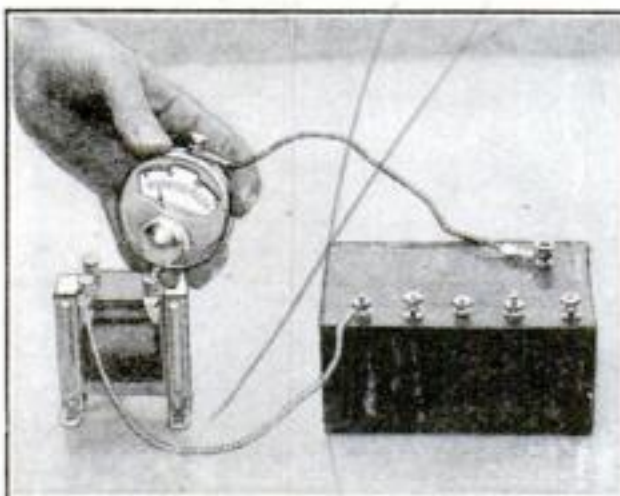


Fig. 6. How to test the transformer for open circuits, by using the voltmeter and battery

be touched to the core or case of the transformer and the other test point touched first on one terminal of the primary, then on a terminal of the secondary. No readings should be obtained during this test.

The binding posts and screws of rheostats and other parts should be tightened



Fig. 7. Before connecting the rheostat with the circuit, tighten all connections as shown

up carefully before being used in the circuit. Neglect of this precaution often is the cause of troubles impossible to locate later on.

Condensers should be tested as shown in Fig. 8, one test point being connected with one terminal of the condenser and the other test point with the other con-

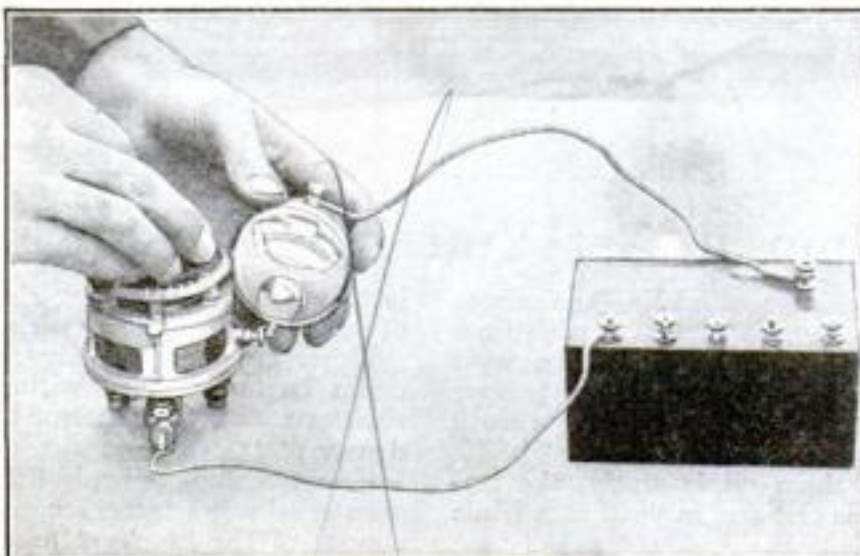


Fig. 8. This illustration shows the method of testing the condenser for short circuits, using voltmeter and battery

denser terminal. While the test circuit is connected, the rotary plates should be revolved. During this operation, the needle should not falter. If it does, it indicates that at some point the rotary plates are touching stationary plates or that dust is short-circuiting the plates. If the short circuit is caused by dust, the spaces between the plates should be cleaned by blowing through them; if by touching plates, the rotary plates should be straightened carefully.

Rubbing contacts, either in variocoupler, variometers, or variable condensers, should not be relied upon. The best method is to connect the leads, terminals, or parts with soldered flexible connections.

Provide Stops for Rotors

Stops should be provided to prevent rotors of variocouplers and variometers and rotary plates of condensers from being turned through more than one revolution. If this is not done, the leads will be twisted or broken, or the insulation worn off, causing short circuits.

Fixed condensers, especially the grid condenser, should be tested to make sure that there are no short-circuited condensers. When the condensers are connected between the test points, the voltmeter should show no reading.

Jacks contribute a large portion of the troubles in amplifier stages. In double-circuit jacks, poor contact of the inner springs with the outer springs often are the cause of no signals or, at best, weak signals in the amplifier stages. Make sure before you connect the jacks that they are free from this fault.

Testing Circuits for Opens

After you have connected the set, test the various circuits for opens before connecting the batteries. In the plate circuit, for instance, touch one test point to the plate terminal of the socket, and the other test point to the positive B battery connection, to make sure that there is a complete circuit between those points. The same should be done with other parts of the circuit.

Before you jump to the conclusion that something is wrong with your set, try various values of B and C battery voltage, since the correct values are important if distortion is to be eliminated.

If you don't get results after making tests and checking up your wiring, you will find it an actual saving in time and temper to take the whole works apart and make the tests on the apparatus as I have described them.

Don't try to make all the tests, wire up the receiver, and get good results all in one evening. It simply can't be done.

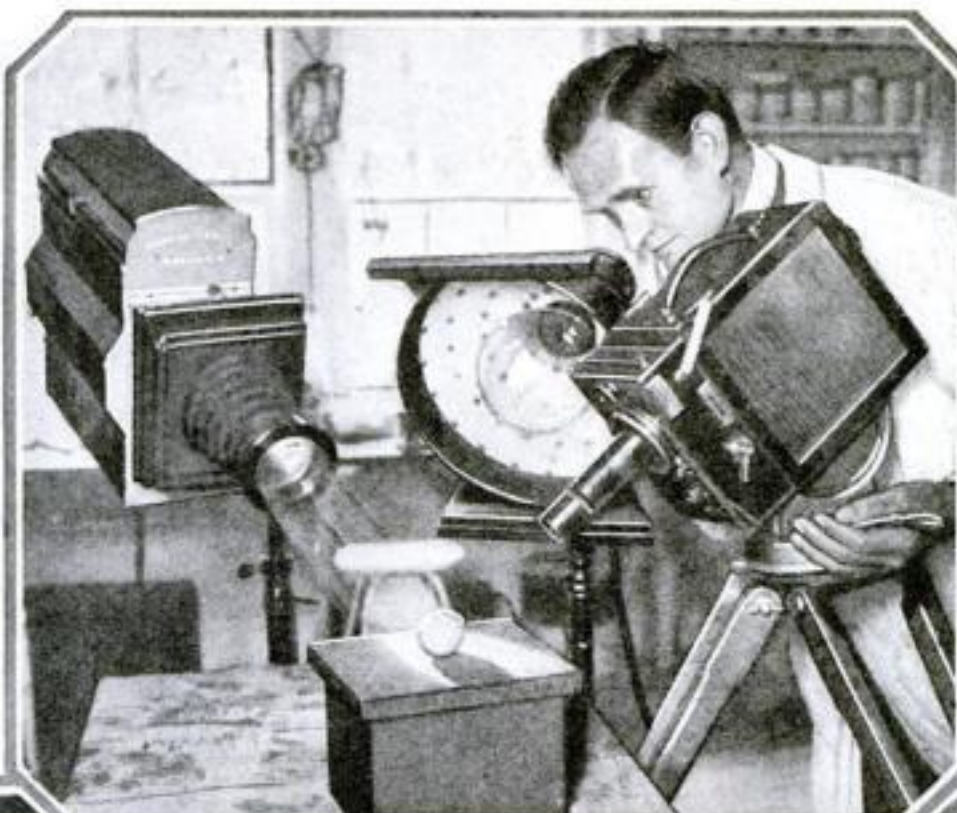
NEXT month Jack Binns will tell of the most recent progress in the development of secret radio and of the possibilities of private wireless communication. Don't miss this timely article on the discoveries of the day.

Evolution of an Egg in the Movies

By Charles F. Herm
Formerly of the American
Museum of Natural History,
Inventor of the Motion-
Picture Camera to Photo-
graph Embryo Life

THE untiring eye of science is the motion-picture camera. The human eye has its limit of endurance. That means, of course, that a scientist observing a delicate but slow process beneath the microscope cannot see the full sequence of the process.

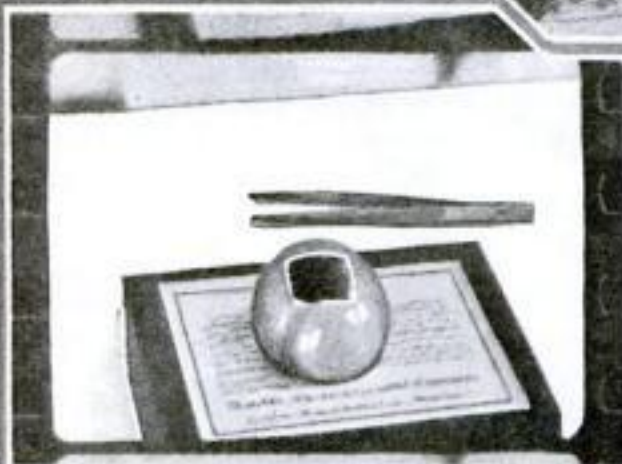
But the motion-picture camera does not tire. It sees, and records, the most minute details. We have already traced, without a single break in the sequence, the



first stir of life within a fertile egg. We have traced the life history of germs in segregated living tissue!

My movie photographs of the growth of the embryo within the egg, some of which are reproduced here, were obtained by focusing the "time-condensing" camera into the egg, through a small window cut in the shell.

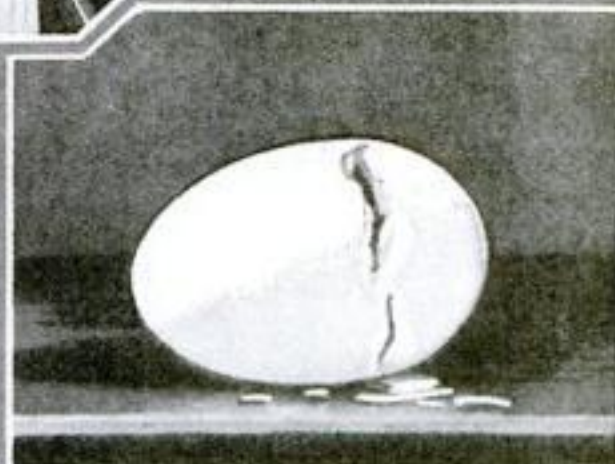
It has required six years of my time to adapt the motion-picture camera to scientific uses. But now I know that the life history of disease germs will be solved; and I dare to hope that the camera may solve science's greatest enigma—the development of embryo life.



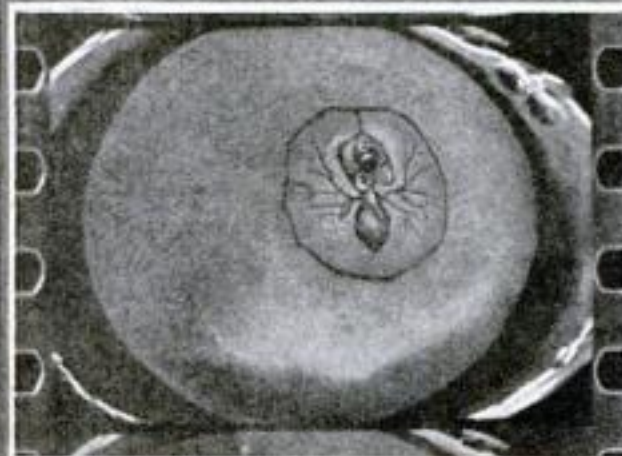
1. Fertilized egg prepared for photographing, with sealed window in the top of the shell for observation of the growth within



4. The embryo at the end of 10 days. The top picture shows Doctor Herm making these remarkable embryo photographs with his newly invented movie camera



7. The camera now gives a complete picture story of the hatching, showing how the chick breaks the shell a little at a time



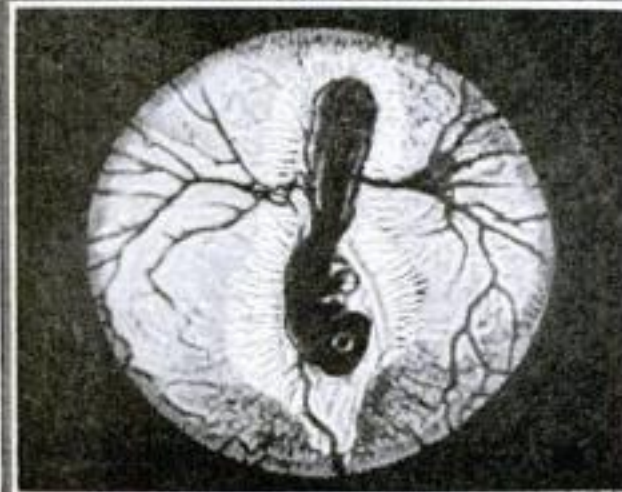
2. Interior view of the same egg, showing the growing chick embryo only 24 hours old



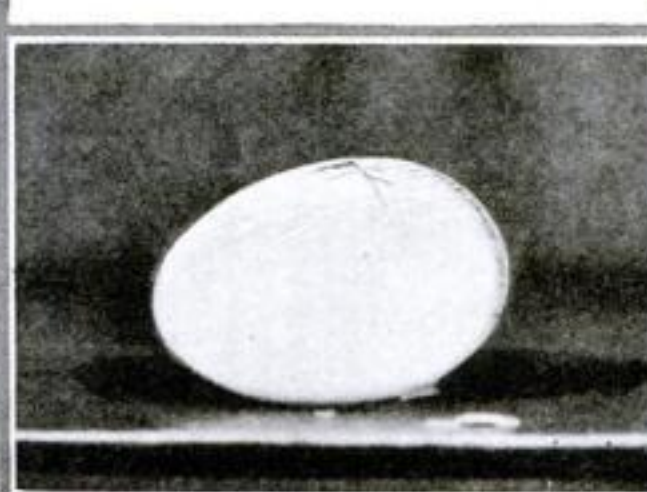
5. At the end of 20 days. Here the embryo is shown almost fully developed, imprisoned in the shell from which it must free itself



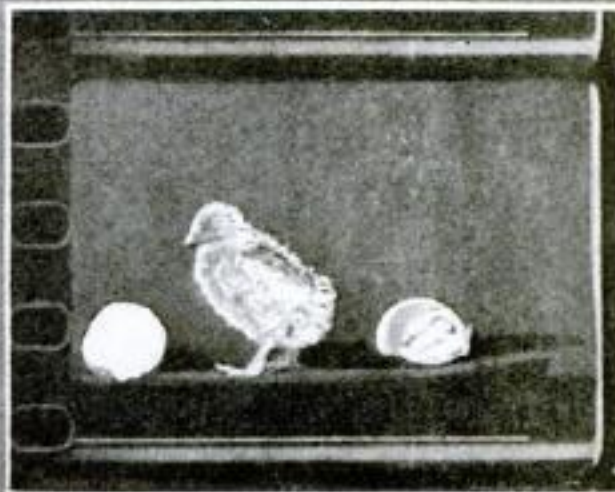
8. Hatched. Still weak and wet, the newborn chick has chopped its own way out



3. The embryo at the age of 56 hours. The camera is driven by a time clock that automatically photographs a motion picture of the embryo's progress every few seconds



6. Beginning to hatch. The small crack at the top of the shell shows where the chick is just beginning to pick its way through



9. The baby chicken! From the first stir of life in the shell, the camera has recorded a continuous story of the processes of incubation to preserve for scientific study

New Mechanical Servants Invented



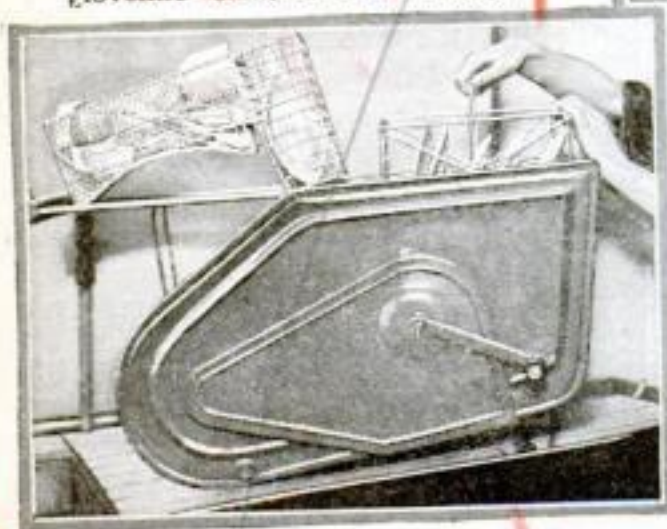
A twist of this little cutter is said to remove the shell cleanly from the top of an egg by means of toothed spring jaws



This wire egg rack is designed to prevent eggs from cracking when inserted in boiling water. The handle attachment spares the fingers. The device is collapsible



This dusting mitten can't slip off, it is claimed, because of glovelike compartments inside



Dishes are washed simply by turning the handle of this machine containing boiling water and washing powder



Photo from Hunting
In the battle to protect clothing from moths that destroy more than \$100,000,000 worth of goods yearly, this household all-metal clothing vault has been devised. It is airtight. Within it garments are fumigated by chemicals that are said to kill the larvae as well as the moths



Foot pressure on a lever swings open this sanitary refuse can. A counterweight swings the can back under the cover



Here is a splashless colander. The under part of the cover has a perforated disk that presses the water from the contents. The device also can be used as a baby's bottle sterilizer



This combination sifter and ash-can is said to be dustless. A pail filled with ashes is inserted in the lid and covered by a sieve. Turning a handle revolves the pail

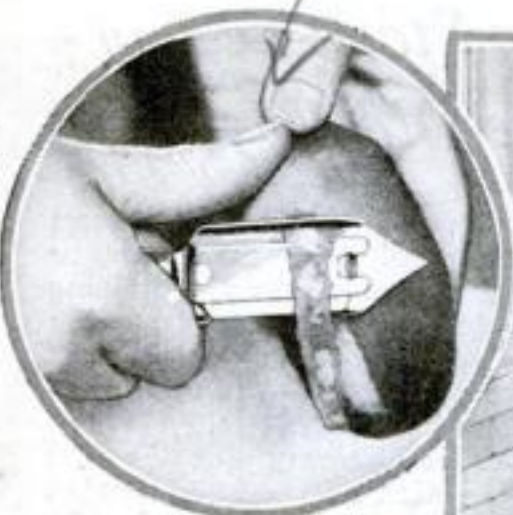


Turning an indicator on this metal needlecase to the desired number, then tipping the case, delivers the size needle you want

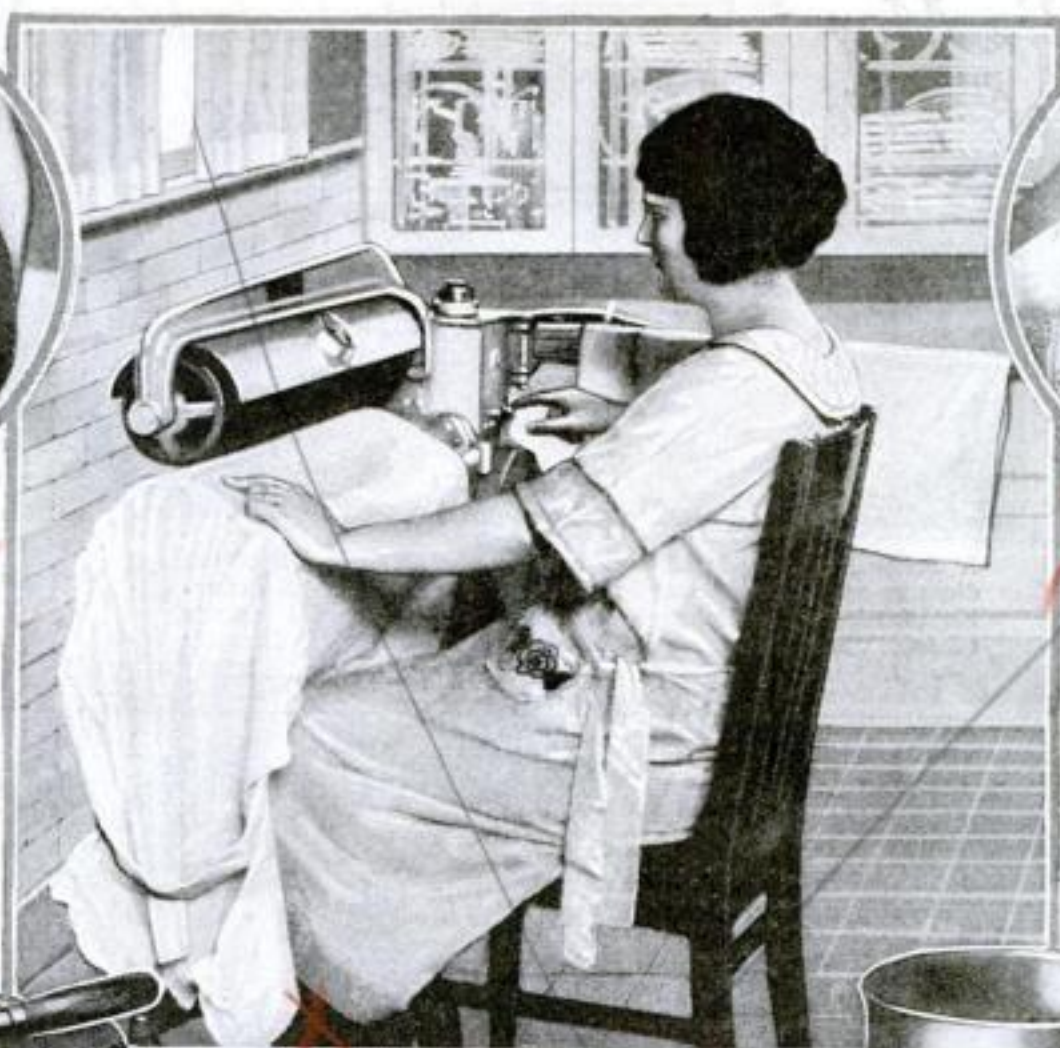


A small electric heater attached to an electric fan can be used for drying the hair, drying clothes or heating a small room

to Lighten the Housewife's Tasks



Used safety razor blades that otherwise would be thrown away fit in this ingenious potato peeler almost instantly, insuring a keen edge always. A safety guard over the blade protects the thumb of the worker



Backaches are eliminated from ironing day by a newly perfected electric ironer that can be operated while the housewife sits in a chair. A roller controlled by an electric button is said to iron clothing of all kinds, even starched garments



Boiling eggs without water is the feat claimed for a small electric cooker and toaster. The eggs are placed in a perforated container between two heat reflectors that radiate the heat evenly



Instead of flying into the face of the housewife, fish scales roll from under the blade of this scaler



Pressing a spring lever beneath this hot-pan lifter engages the jaws on the edge of the pan



Here is a midget electric range that can be plugged into an ordinary apartment wall socket



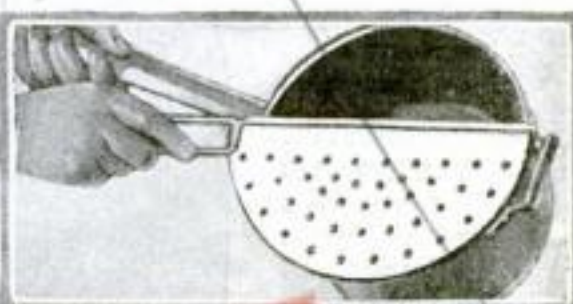
One of the newest conveniences for the small apartment or home is an electric ironing machine that folds back out of the way into the kitchen or hall closet



An easily adjusted gear mechanism driven by a small motor turns the ice-cream freezer with ease



A wrench for removing preserve-jar caps without breaking them and for lifting jars from boiling water, consists of a gripping spring band with plier-like handles



A small hand colander consists of a perforated semicircular plate with a flange to hold it close against the edge of a pan when water is drained from vegetables

Science Nears Tomb of First Man

*Fossils of Mongolia May
Reveal Secret of Life*

*Expedition Starts Soon to
Solve Age-Old Mystery*

By Truman Stevens

INSPIRED by the success of their previous expedition, so startlingly productive of finds of tremendous scientific significance, a band of American scientists this spring will guide their motor cars again into the great Gobi Desert of Mongolia, seeking to wrest from the bosom of the earth a scientific solution of the supreme mystery of nature—the origin of man.

The expedition will be led by Roy Chapman Andrews, of the American Museum of Natural History, who returned recently from Mongolia after two years of exploration that resulted in what have been called the most important and spectacular discoveries of their kind.

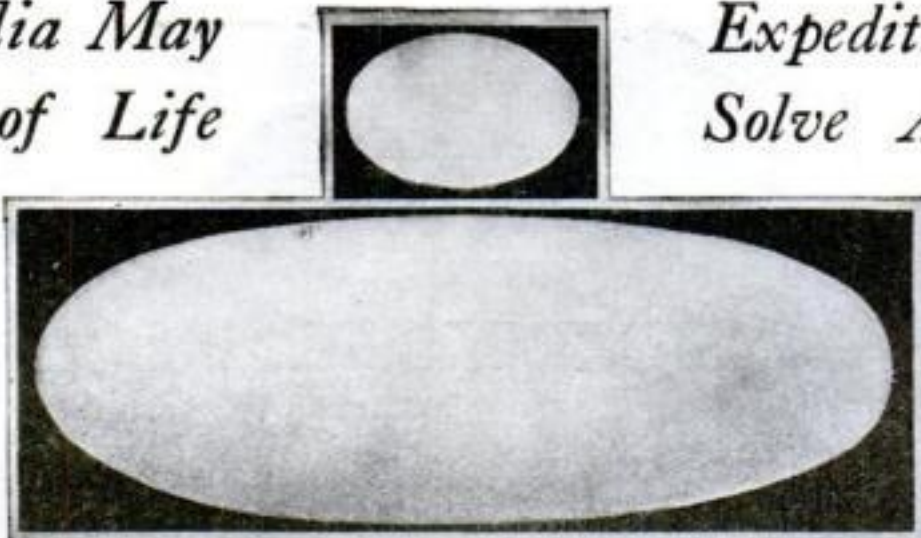
America and Asia Linked

These discoveries, scientists say, prove indubitably that North America and Asia at one time were linked by land, and supply all but direct evidence that central Asia was the fountainhead from which sprang human life. That Central Asia was the source of most of the other forms of animal life now on earth the recent expedition proved virtually beyond question.

In the search for evidence of the birthplace of man, the scientists will seek the fossilized bones of primitive men believed to have lain buried in the Mongolian rocks for millions of years. That the bones are there, the members of the expedition are certain.

"I believe unquestionably that Mongolia will yield the remains of primitive man," said Mr. Andrews recently, speaking through courtesy of the American Museum of Natural History and *Asia Magazine*, joint sponsors of his first expedition. "We did not exhume the bones of the progenitors of the human race on our initial exploration simply because we did not reach the proper strata of rock. We learned much as we searched, however, and I am confident that on our next trip we shall get there."

Probably the most



A dinosaur egg compared with a hen's egg. The length of the dinosaur egg (below) is eight inches; the diameter $2\frac{4}{5}$ inches. Note its elongated shape as compared with the oval hen's egg (above), which is about $2\frac{1}{4}$ inches long and $1\frac{7}{16}$ inch in diameter



A nest of fossilized dinosaur eggs found on the Mongolian plains. The eggs probably are just where they were laid more than 10,000,000 years ago. Other eggs were discovered in the rock ledge shown in the center of the photograph. The fossilized bones of a prehistoric dinosaur were found a short distance away. The explorers assumed this huge reptile to be the one that laid the eggs



Restoration of the giant browsing rhinoceros which, as far as science knows, was the largest mammal that ever walked the earth. It was as large as a locomotive. Its fossilized skull was exhumed in Mongolia by the Andrews expedition and has been placed on exhibition at the American Museum of Natural History, in New York City

important scientific treasures unearthed were 25 dinosaur eggs, some of them containing embryo dinosaurs. A number of eggs were found in the nest where they were laid more than 10,000,000 years ago.

This discovery was the first revelation science has had that dinosaurs—huge lizard-like creatures that walked the earth eons before the dawn of history—laid eggs and cared for their young as do the tiny reptiles that we know today. Moreover, when the rocks about the nest gave forth 70 skulls of the dinosaur *Protoceratops*, the layer of the eggs and ancestor of the great horned dinosaurs that once inhabited America, they supplied incontrovertible evidence that Mongolia and the Rocky Mountains once were connected by land. In other words, in the early age of mammals, America and Asia made up one continent.

The Birthplace of Man?

The explorers reason that since the Mongolian plains once fed the ancestors of the animals of America and Europe, the ancestors of man likewise must have lived there.

Picture a hyena, more than twice the size of a horse, with a jaw spread of little less than a yard, capable of devouring a man almost in a gulp! That is the sort of creature that stalked through the American-Asiatic continent when man first appeared on earth. The expedition brought back with it the skull of this enormous animal.

Larger still, though probably not so dangerous, since it was a vegetable-eating animal, was the rhinoceros of that period. The expedition also exhumed the skull of one of these—the largest land mammal known to science.

Twenty skulls of a huge beast that science knows only as *Titanotheres* likewise were discovered, additional evidence that America and Asia once were united; for the first fossilized specimen of this beast was found some time ago in South Dakota.

Quite as amazing in its relation to the weird changes that the land mass of the

All photos courtesy of the
American Museum of
Natural History and
Asia Magazine

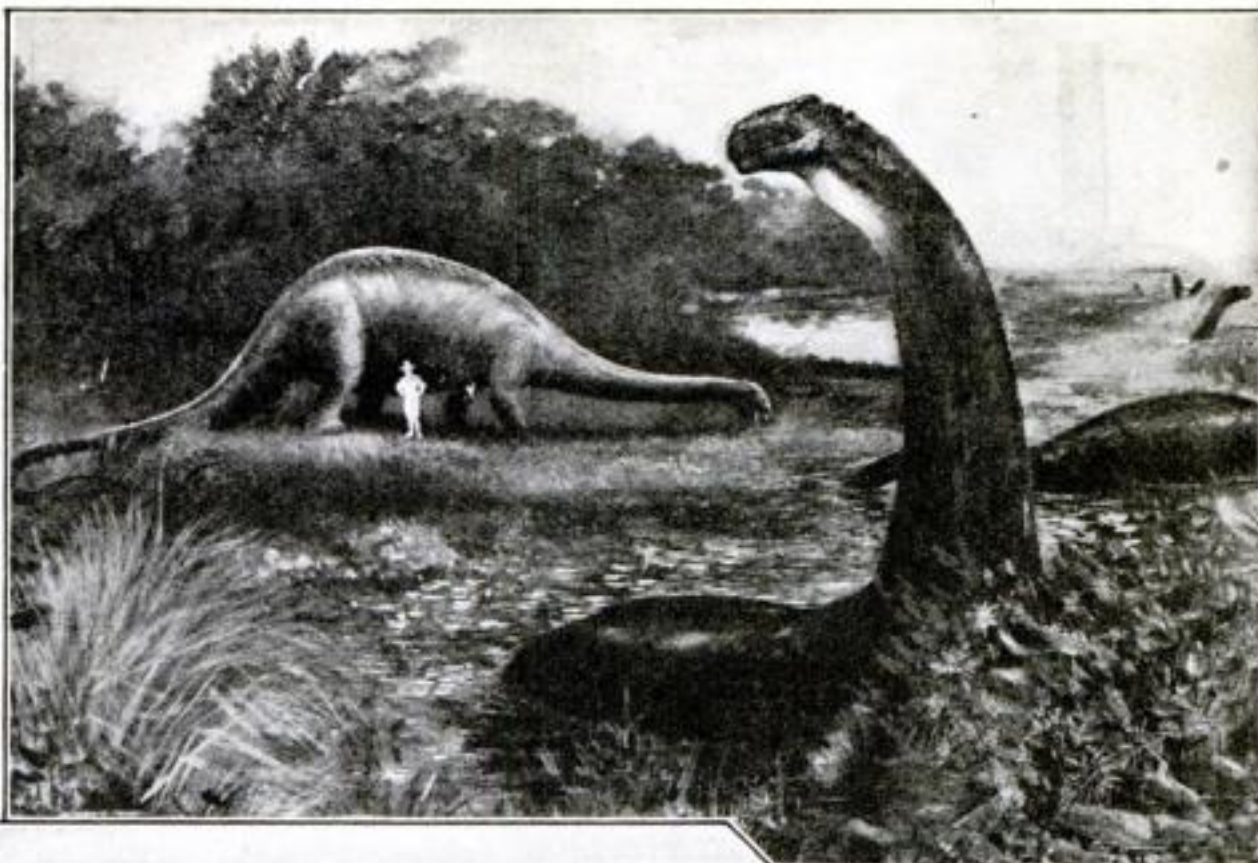
earth has undergone since the beginning of creation, was another find—a vast deposit of fossils of invertebrate sea creatures. These indicated that a wide sea-way extended straight through Mongolia in what geologists call the Permian times—when most of the northern hemisphere was below sea level.

Nine Tons of Fossils Found

The expedition obtained countless specimens of living animals, birds, fishes, and reptiles. In all, more than nine tons of fossils were exhumed, the largest collection ever taken by any expedition in a single season. In addition, a vast area was mapped, important geological discoveries were made, and the longest geological cross section ever completed in reconnaissance was executed by the scientists in their preliminary survey of the country.

Ten years' work, says Mr. Andrews, was accomplished in two summers of five months each, made possible by the fact that the expedition traveled in motor cars—supported by a caravan of 75 camels. These carried gasoline, food and other supplies to the camp sites. Thus the expedition used one of the oldest and one of the newest methods of transportation known to man. The automobiles covered from 125 to 150 miles a day, and amazed the natives, whose laden camels can negotiate only about 15 miles in a day's travel.

"Our expedition," says Mr. Andrews, "was a triumph of American enterprise—not so much on the part of us who performed the work of exploration as of those who made it possible. It was an American, Professor Henry Fairfield Osborn, president of the American Museum, who in 1900 advanced the theory that the origin of life might be found in central Asia. It was characteristic of the adventurous spirit of the American business man and his interest in science that \$200,000 was advanced to back that theory. Our equipment was supplied us. Our way was made smooth. We had only to achieve our objective."



Dinosaurs as they appeared in prehistoric ages—a scientific restoration from fossilized remains. This huge lizard-like creature measured from 60 to 80 feet from head to tail. The figure in white shows the comparative size of a man.



Left to right: Prof. Henry Fairfield Osborn, president of the American Museum of Natural History; Roy Chapman Andrews, leader of the expedition, and Walter Granger, chief paleontologist, standing on the rim of a pit from which a large number of dinosaur bones were unearthed. Are the bones of original map close by?

Pushing the expedition to its successful completion, however, was by no means as simple a task as Mr. Andrews modestly pictures it. The scientists met with no thrilling adventures, he declares; yet it is a matter of record that on several occasions the members of the expedition were attacked by the giant, savage dogs that infest the country, probably the fiercest creatures on earth. The dogs feed almost entirely on human flesh, due to the Mongol custom of casting the bodies of their dead out on the plains.

On one occasion a pack of fourteen of these savage brutes attacked Mr. and Mrs. Andrews as they slept in the open at night. A lucky shot from a small-caliber rifle killed the leader of the pack, and, while the other dogs devoured their fallen leader, Mr. Andrews was able to get a larger rifle and kill enough of them to send the whole pack scurrying away in panic.

Venomous vipers, that constantly lodged themselves in the shoes, socks, and clothing of the explorers, constituted another danger with which the expedition contended. At first the explorers encountered hostility from the natives, who

could not believe that an expedition of more than 30 members, traveling in "wind cars" (*chi-churs*), would invade the country for any such absurd purpose as to "hunt bones." This hostility was not manifested in any violent form, and it subsided rapidly when the natives understood that the quest of fossils actually was the only purpose of the white foreigners.

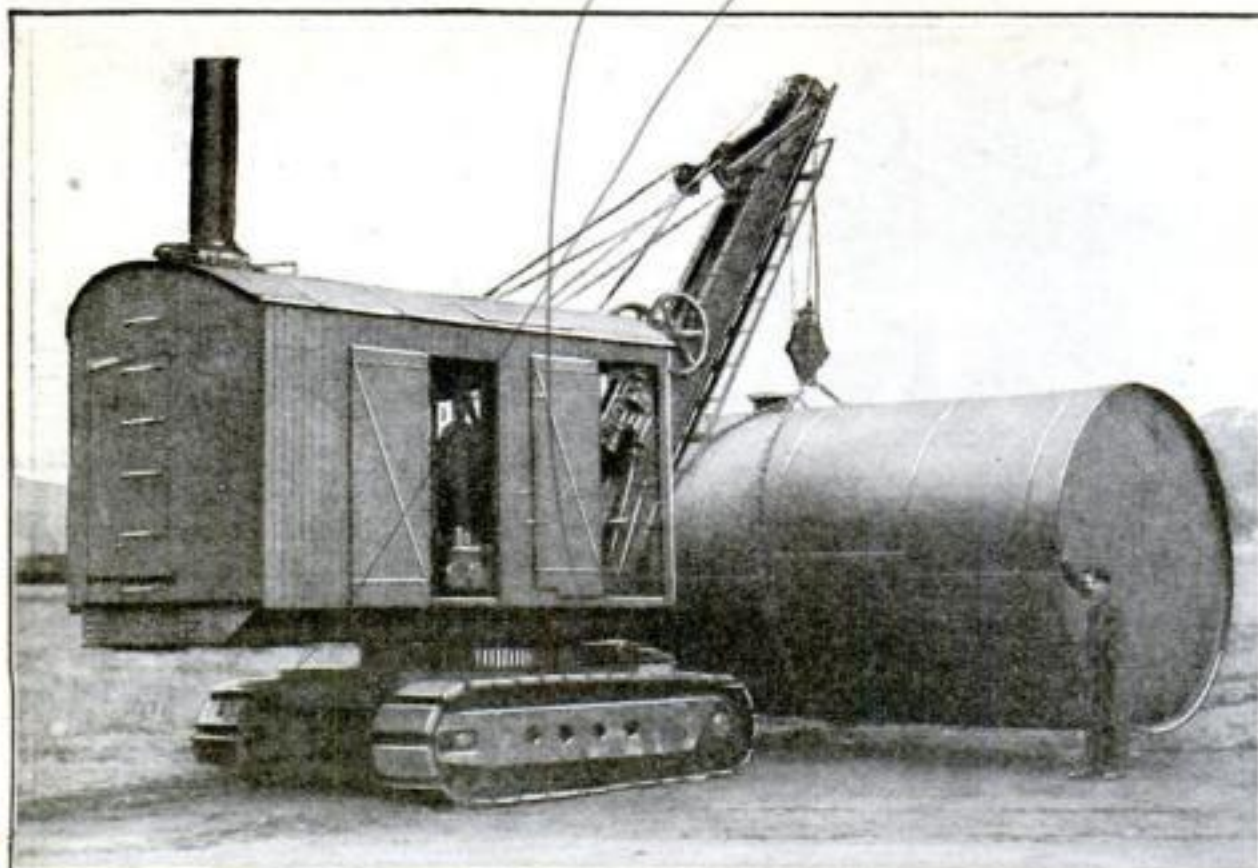
The leader of this epochal expedition is a slender, scholarly appearing, soft-voiced, and gentle-mannered man of 39, a zoologist, whose place, one would say, would be in university halls rather than in pushing perilous exploration through unknown lands. Yet since 1908 he has spent more of his time in adventurous research in remote regions of the world—Alaska, Borneo, Corea, China—than in civilization. Until he was placed in charge of the expedition into Central Asia, his specialty had been hunting whales. He was the only naturalist who devoted himself exclusively to that thrilling and hazardous quest, and he has faced death many times.

Search Will Last Five Years

And now Mr. Andrews is eager, impatient even, to return to Mongolia, where he will give five years to completing his search for what he calls the "paleontologic Garden of Eden." No expedition of history—not even the numerous heroic dashes for the North Pole, or the first daring voyage of Columbus—ever was fraught with more thrilling and dramatic possibilities than are contained in the prospect of bridging the gulf of millions of years and solving for man the riddle of his origin.



Walter Granger preparing a fossil for shipment. He is strengthening it with paste bandages, made of flour and old clothes



STEAM SHOVEL CARRIES HUGE TANK

A STEAM shovel mounted on endless treads recently solved uniquely a knotty problem confronting a contractor who, in building a gasoline filling station, found it necessary to move a 15,000-gallon steel storage tank, weighing nearly six tons, a quarter of a mile. Because of the enormous weight of the tank and its large dimensions—25 feet long by nine feet in diameter—ordinary hauling methods were out of the question.

A steam shovel near the scene gave the

contractor his inspiration. After the dipper and dipper handle of the shovel had been removed, a chain cradle placed around the tank was made fast to the sheave block. The now shovelless shovel easily lifted the tank clear of the ground. With a man walking beside each end to prevent undue swinging, the great tank was carried the quarter mile and placed in a 12-foot excavation.

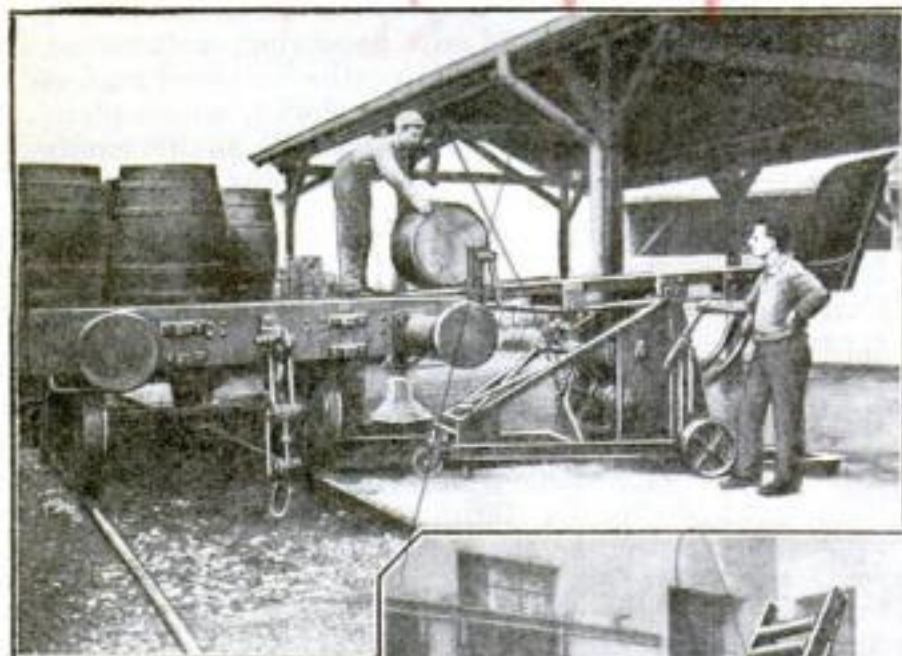
The entire operation required, it is said, less than one hour.

MECHANICAL LOADER IS LABOR SAVER

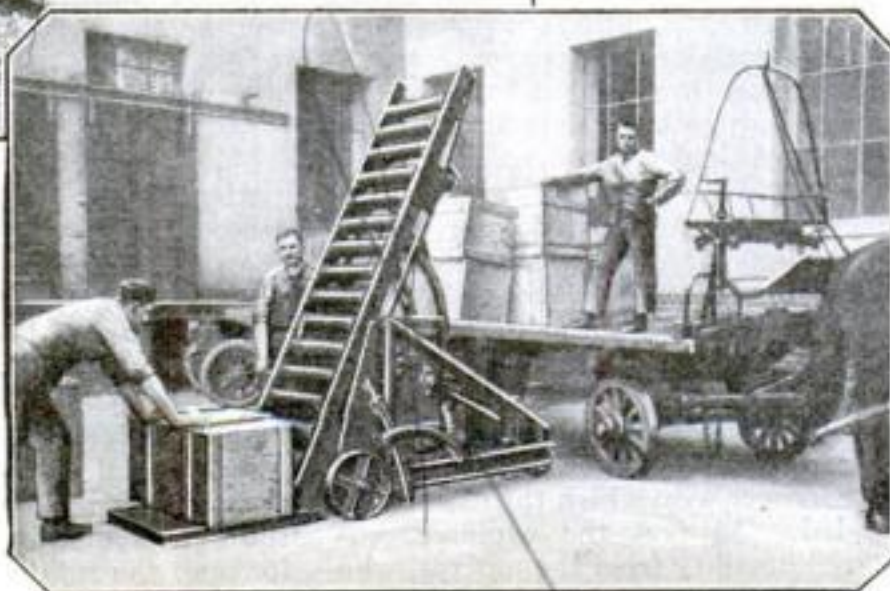
OPERATING on the seesaw principle, a loading truck invented in Germany is said to enable one or two workmen to accomplish the work of six. Containers weighing half a ton can be handled by one man, aided by the machine, it is claimed.

A steel frame supporting a skid, consisting of a series of roller bearings, is mounted seesaw fashion on a stout support that rests on a three-wheel truck. The loading frame or skid has at one end a platform that rests on the ground to receive the load.

The workman, turning a crank, raises the loading skid until the end opposite the load is lower than the fulcrum of the seesaw. The load then rolls down the rollers of the skid to the car or truck. The loader can be wheeled easily from place to place. During loading it is held stationary by brakes.



Above: The skid elevated to an inclined position, permitting lifted barrels to be rolled on roller bearings to the truck. At the right: Loading a packing case on the lift platform. When the operator turns a crank, the pivoted seesaw skid is elevated to the slightly inclined position shown above.



How to Shut Off Water in Repairing Faucet

THE problem of the leaking water faucet is one that presents itself occasionally to almost every home owner. Usually the cause of the leak lies in a washer that has become worn. To replace it with a new washer is a simple job; but first the water must be turned off or the pressure in the pipes reduced.



In case it is found impossible to shut off the water from the house, a plan recommended by experts is to turn on all the faucets in the house. This will reduce the pressure sufficiently to permit work on the damaged faucet.

Electric Motor Drives the Old Farm Pump



Well pump with electric motor attached

USE of electric power on the farm has progressed to a point where even the old-time hand pump is driven by motor.

Designed especially for this purpose, a newly perfected motor of one quarter or one half horsepower, inclosed by a rust-resisting metal box, drives the pump at 35 strokes a minute. The length of the stroke can be adjusted to accommodate various well depths and cylinder lengths.

Either alternating or direct current can be used. A pushbutton starts and stops the pumping. The mechanism can be installed in an hour, it is claimed, and soon will pay for itself in saving the time and labor of the farmer.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.

Every Pile of Tin Cans Is an Iron Mine

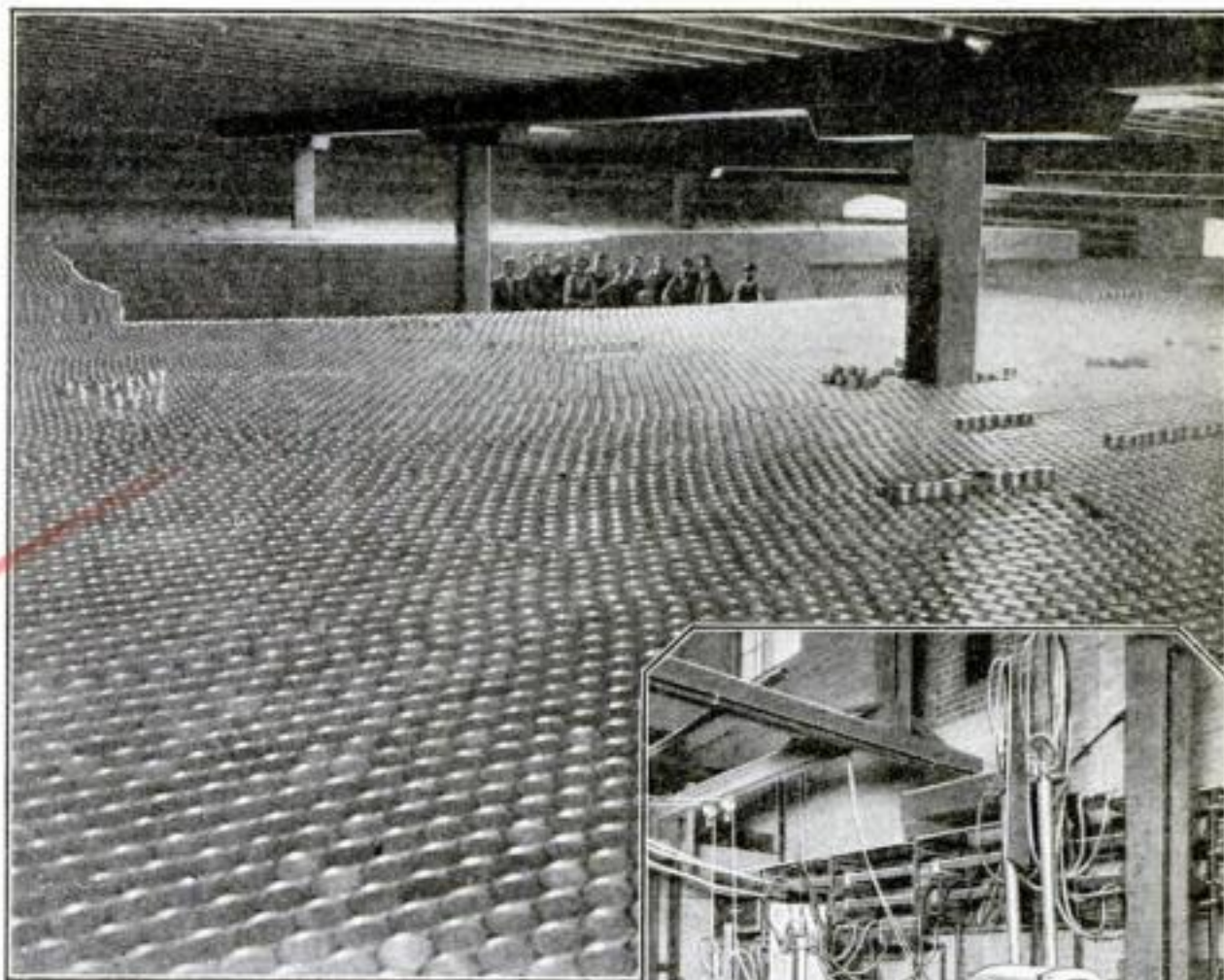
THAT sorry procession of empty tin cans that passes continually through your back door to ignominious oblivion soon may be knocking at your front door in the form of brackets for your walls, sash weights for your windows, griddles for your kitchen stove, and grates for your furnace.

In a series of experiments recently concluded by the Northwest Experiment Station of the Bureau of Mines, Seattle, the Great American Can has been converted successfully into synthetic iron for any use to which ordinary pig iron can be put.

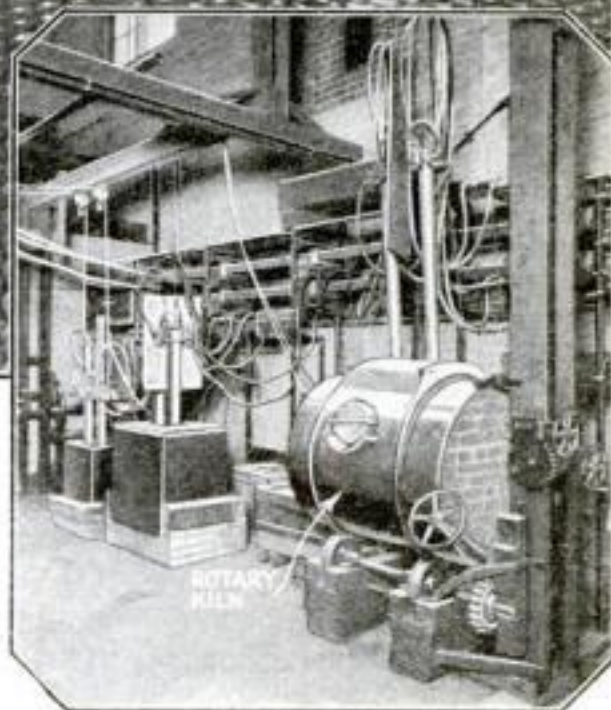
The millions of cans that are wasted each year (from 160 to 200 are used by each of the 25,000,000 families in the United States) contain very little tin. All but one per cent is iron. The problem of salvaging them heretofore has been the difficulty of separating the tin from the iron so that the latter might be used.

The melting temperature of tin is 232°C ., while that of iron is 1500°C . Attempts to melt all the tin off proved unsuccessful. But the Seattle experimenters overcame this limitation by adding scrap iron to the metal obtained from melting the can scrap, thus reducing the proportion of tin by diluting it.

Heavy sections and thin ornamental



Above: A sea of tin cans waiting to be used and thrown away. Right: The laboratory where cans are converted into usable iron



castings were made of the new metal. It was found to be amply soft, and to yield properly to a carbon drill or lathe.

Small Tractor Converted into Power Shovel

THE small tractor can be converted quickly into a diminutive and mobile power shovel when equipped with a recently patented attachment consisting of a broad shovel, holding half a cubic yard, and fastened to the front and rear axles of the tractor. The machine is especially useful on small jobs such as digging cellars, ditching, loading wagons or shoveling snow.

Power for raising and lowering the shovel is supplied by the tractor engine through a pulley attached to the right side of the tractor. A steel rope passing around a drum at the rear, operated by a trip lever beside the driver, manipulates the shovel.

The driver sends the tractor forward in low gear. A lever lowers and raises the shovel as required.



One Man Controls Great U. S. Dreadnaught

THE brain of Uncle Sam's mighty dreadnaught *Colorado* is in the little room shown above. From it every movement of the great war-ship can be governed by one man through a marvelous electrical control system. The long levers control 30,000-horsepower electric propelling motors. The short handles control the throttle valves of giant steam turbines. These turbines drive electric generators that provide the power for the electric motors. The motors, in their turn, drive the great propeller shafts.

One-man control is the last word in the navigation of battle-ships. Heretofore six men have been required as a control-room crew.



Power shovel used for excavating

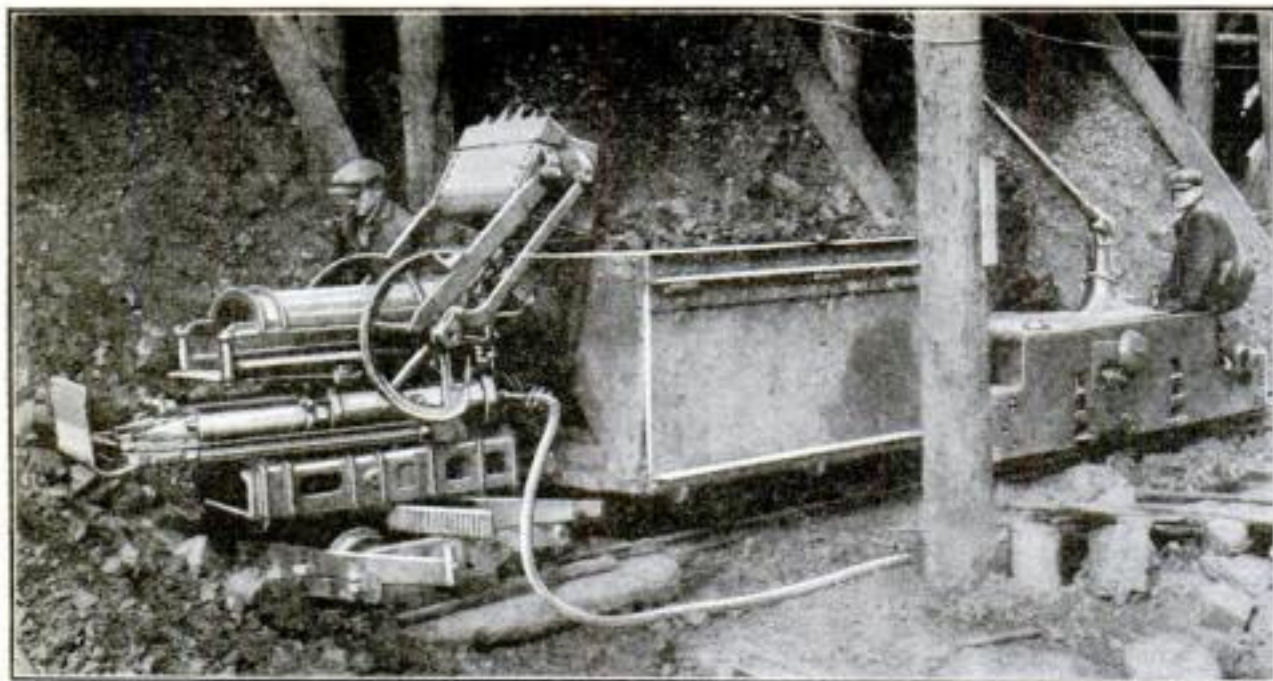
Car-Drawn Mower Cuts Weeds along Tracks

WEEDS along the tracks of an inter-urban trolley company of Rockford, Ill., caused considerable trouble and expense every summer, until an employee of the company hit upon the idea of hitching a mowing machine, of the type commonly used on the small farm, to a trolley car and hauling it over the right of way.

By the new arrangement, the mowing machine is equipped with flanged wheels to fit the tracks and the tongue of the machine is attached to the rear of a car. As the mower is hauled along the tracks, the cutting blades can be raised or lowered.



Mowing weeds along the right of way



DIGS AND LOADS BY COMPRESSED AIR

AN UNUSUAL digging machine that combines the processes of shoveling and loading is finding its way into hundreds of mining and construction jobs. It is operated and driven entirely by compressed air.

The speed of the loading can be controlled so as to throw the material to the farther end of a long car, or merely to drop it into a short one.

The mechanical shovel will dump its load into the center of the car from any position, even extreme right or left, it is claimed.

Compressed-air power is applied through direct thrust cylinders. Three control levers successively crowd, dig, and dump the shovel.

The two middle cylinders, acting as one, which do the main digging, are provided with cataract oil escapement plunger pistons. This arrangement is declared to give a steady and controlled but fast movement, from the first of crowding to the last of dumping, permitting no building up of pressure and consequent jumping, or throwing out of the load.

Penny-in-Slot Elevator

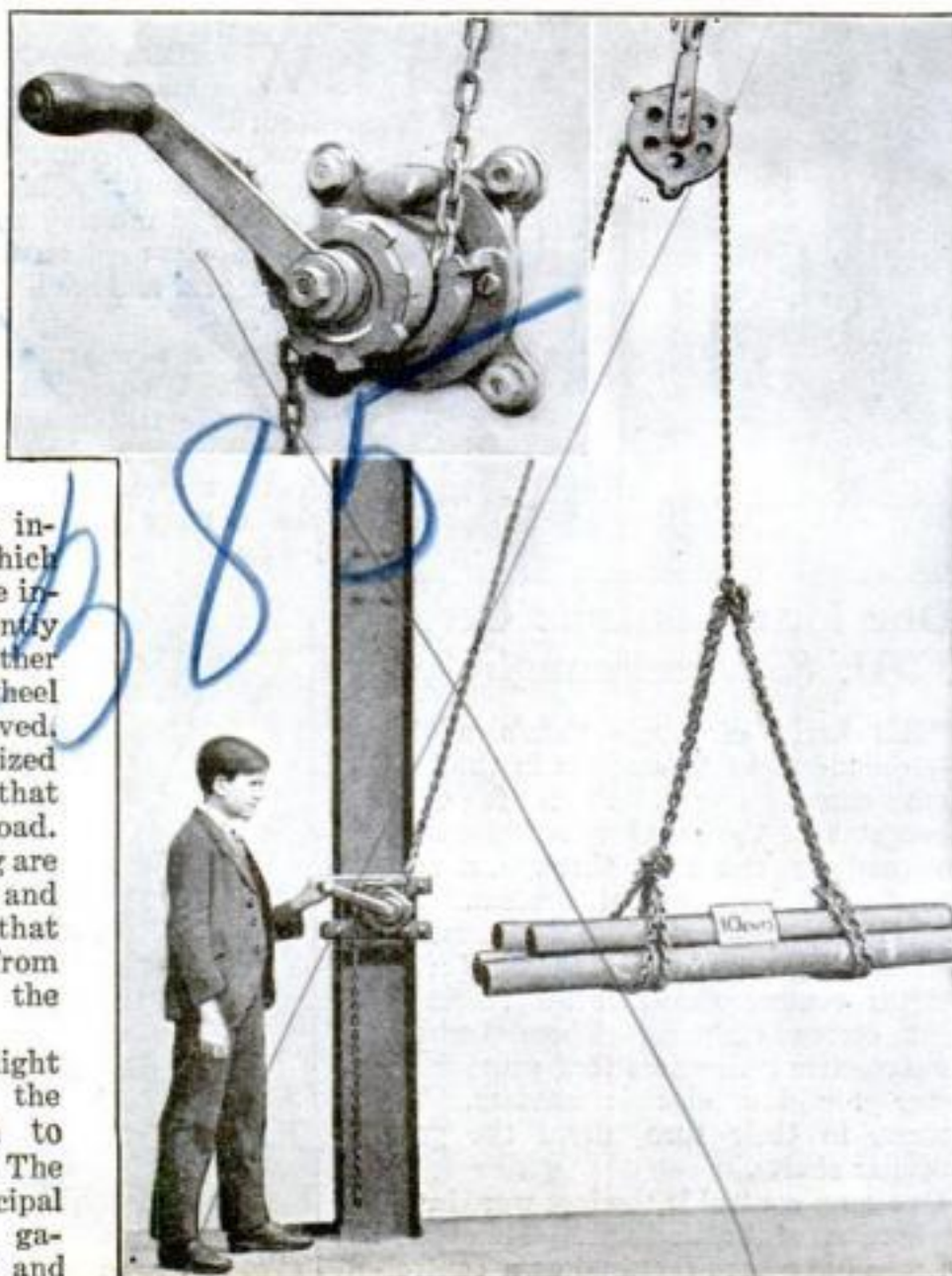
A PENNY-IN-THE-SLOT automatic elevator recently has been invented. Inserting a coin, the passenger enters the car and presses a button displaying the number of the floor he wants. The car automatically stops at that floor.

BOY LIFTS HALF A TON WITH GEAR

THIS novel form of hand lifting gear, by which a small boy may raise half a ton weight as high as 100 feet, has been devised by an English manufacturer.

The apparatus is operated by turning a short handle, bolted to a sprocket wheel. This wheel has one less tooth than the internal gear with which it is connected. The internal gear consequently advances slightly farther than the external wheel as the latter is revolved. This difference is utilized in winding a chain that lifts the desired load. Braking and lowering are controlled by a drum and pawl mechanism that prevents the hoist from overrunning when the handle is released.

A comparatively slight force applied to the handle will suffice to raise a great weight. The device finds its principal use in warehouses, garages, motor works, and on small craft.



Lifting 1000 pounds by the gear shown in the inset

Useful Hand Vise Lathe for Shop or Garage

DESIGNED especially for garage owners, auto

owners, farmers, and machinists, a small but versatile hand vise lathe, recently invented, will make from bar stock such articles as milled studs, setscrews, cap screws, pins, and many other special screws and studs without using an engine lathe or automatic screw machine. The tool also winds wire springs with any pitch desired.

Bar stock up to and including one inch in diameter can be handled. Any required length of screw, stud or spring can be made easily, it is said. Perfect accuracy is claimed. Since the device is hand-fed, the operator can make a fine or heavy cut as the occasion requires.

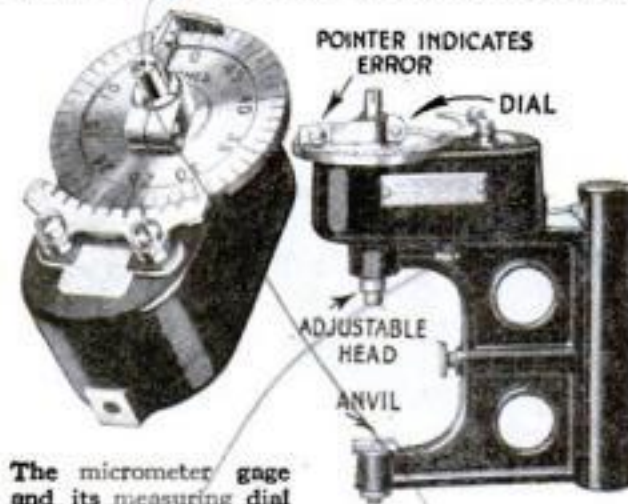


The hand vise lathe

A New Comparator Gage

INDICATING to the thousandth of an inch any variation of a piece of work from a precise standard, a new comparator gage has been designed to supplant the snap and limit gage in repetition or production work.

The gage is set so that if the work measured is exactly standard size, it will give a zero reading. The slightest deviations from the standard are shown on a dial.



The micrometer gage and its measuring dial

In operation, the dial is turned back sufficiently to allow the work to clear the head of a measuring spindle. The spindle is held by an automatic brake. As the work being measured touches a releasing button, the brake is released and the measuring spindle is rotated by a spring until it contacts with the work. This contact position it is locked and the reading appears on the dial.

ENDLESS TREAD ENGINE PULLS SLED TRAIN OF LOGS

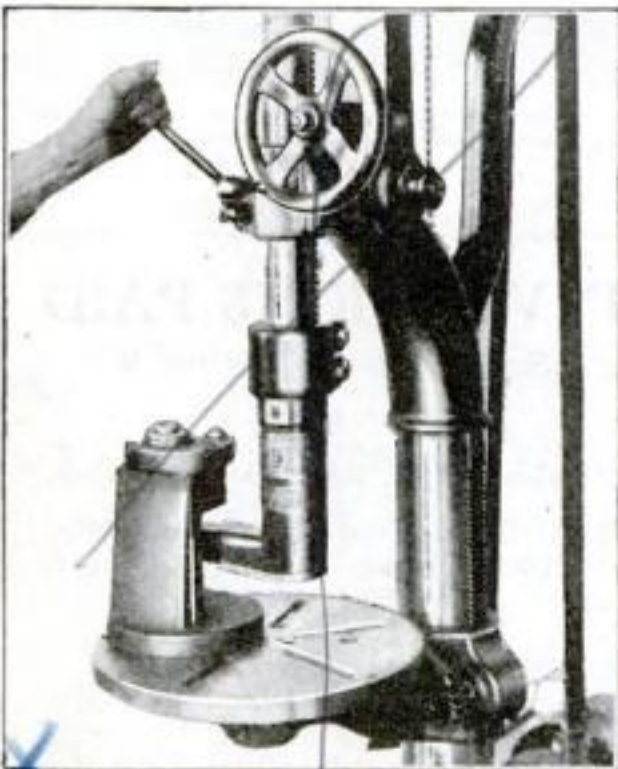


This logging sled train is hauled over the snow by a steam locomotive running on endless treads. The engine pulls 15 "cars"

THE alternative of a costly winter shutdown or the almost as costly use of an army of horses and drivers is circumvented by a northern lumber company through the use of endless tread steam engines and sled trains. Fifteen heavily loaded cars of logs can be hauled at a time over the snow by the steam tractor, which equals the work of 60 teams and their drivers. Moreover, the engine burns wood, while the horses ate costly oats.

The main body of the engine runs on endless treads and the forward part is shed with sleds. The cars run on sleds. An engineer, a fireman, and four lumberjacks can operate one of the trains over the long distances from forest to mill.

Offset Drill Bores Holes in Awkward Places



AN OFFSET drilling attachment has been perfected by a concern in Bridgeport, Conn., to overcome a difficulty that mechanics often encounter—that of drilling and counter-boring holes in unusual and out-of-the-way places where the usual machines will not serve the purpose.

The attachment is so arranged that it may be swiveled around the center of the drill press spindle to the most convenient position. The rotation of the drill spindle is transmitted to the vertical drilling tool at the end of the offset through a square shaft.

The extremely small distance between the tool point and the top of the offset arm permits operation in the most cramped corners.

DREDGING WITH A CHAIN OF BUCKETS

OPERATING on the endless chain principle, this new dredger is said to represent a distinct improvement over the usual suction type. Digging buckets in

an endless chain move about a huge shaft that is lowered diagonally into the water through a well in the bow of the dredging barge, as shown below.



A huge arm carrying a chain of buckets is lowered through a well in the bow

NEW DIESEL ENGINE HAS DISK DRIVE

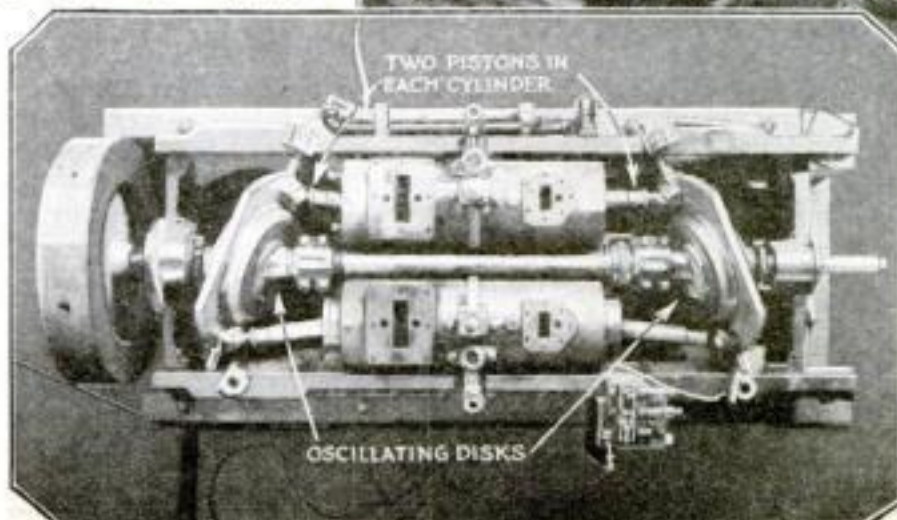
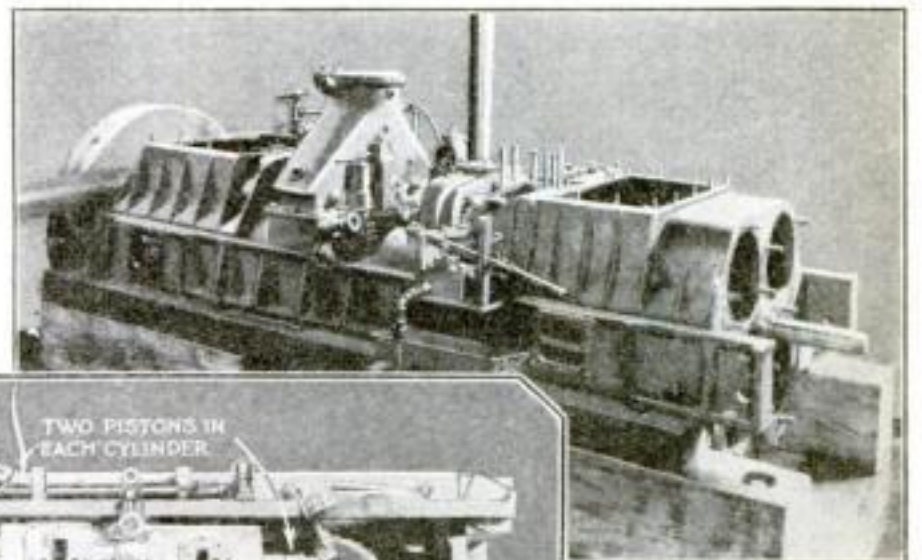
A RADICAL departure in Diesel marine engine design is found in a new crankless, two-cylinder machine utilizing the principle of the oscillating disk to transform reciprocating into rotary motion.

Each of the two cylinders has two pistons, one at each end, attached through ball-and-socket joints to the oscillating disks or thrust plates. While the pistons of one cylinder are moving inward on the compression stroke, those of the other cylinder are moving outward on the power stroke. The intake is on the power

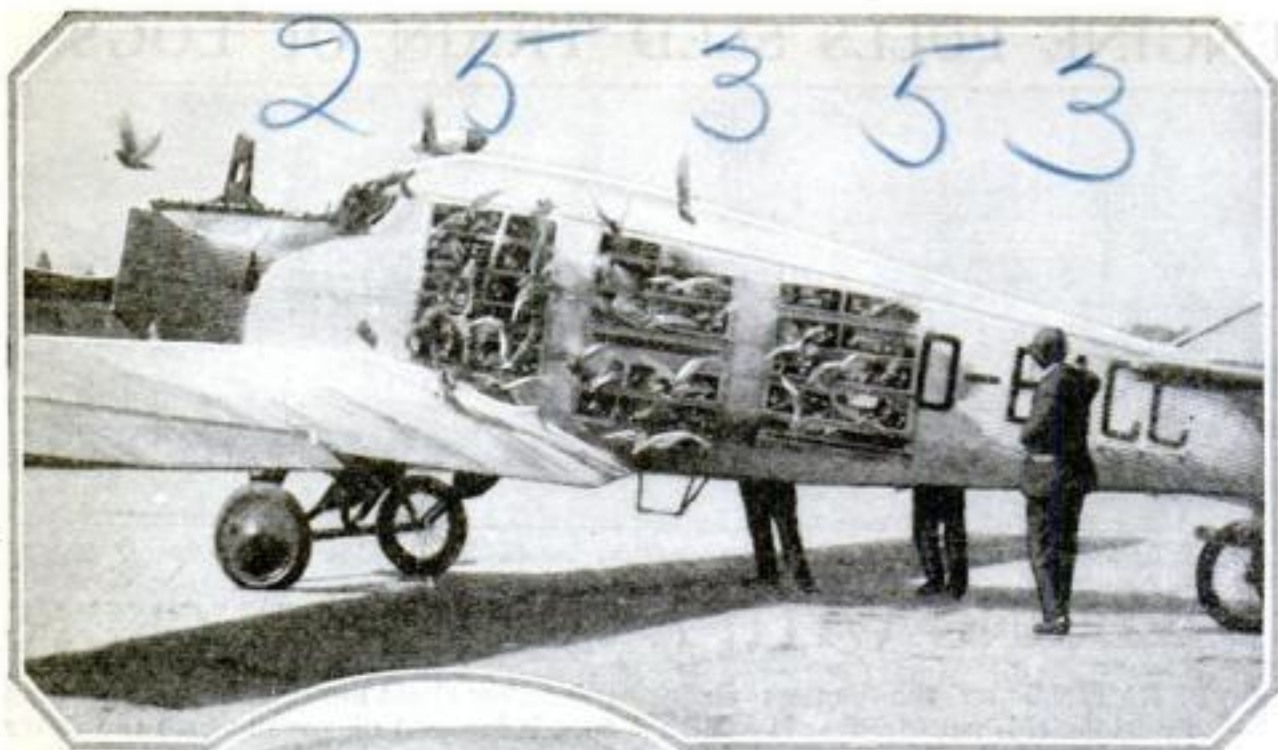
stroke, when a jet of oil is shot into the cylinder and mixed with air.

The power stroke of the pistons in one cylinder forces the pistons of the opposite cylinder together, compressing and exploding the gaseous mixture.

Pressure of the pistons on the sides of the tilted disks operate the drive shaft.



Above: General view of a light and powerful marine Diesel engine of the new type, showing hand lever for producing initial oil pressure. At the left: Plan of engine, showing arrangement of cylinders and oscillating disks that exert a thrust on the drive shaft



Airplane Transports Carrier Pigeons

SUCCESSFUL use of the airplane in transporting carrier pigeons was demonstrated recently at an aerodrome at Bourget, near Paris, France, where a machine especially designed for the purpose arrived safely from Ghent, Belgium. The upper photograph shows the pigeons being released. Part of the immense pigeon house in the fuselage is shown at the left.

This method insures good cage ventilation.

A Shave at High Speed by Motorcycle Barber

NO LONGER need the hurried business man slash ruthlessly at his face in the morning in a desperate race against time to catch the 8:20 train. A motorcycle barber shop, in which he can enjoy all the comforts of a clean shave by an expert barber while he speeds along the streets on the way to his office, is the latest motorized novelty to be introduced at Los Angeles, Calif.

The customer sits in a motorcycle side car, which is equipped with an extra seat for the barber just behind the driver's seat. A small electric heater provides plenty of hot water for the shave.

A regulation barber pole surmounts the hood of the sidecar.



The motorcycle barber shop: Giving the business man a clean shave on the way to work. Note barber pole in front of car.

CONTEST WINNERS TELL HOW THEIR INVENTIONS PAID

The prize-winning letters in the POPULAR SCIENCE MONTHLY contest, "What a Small Invention Did for Me"

First Prize, \$20

By John Boyd, Flint, Mich.

WHEN I had an opportunity to go on a bench job in an automobile factory, I determined to make good. My mettle was challenged, because my predecessor had been unable to produce up to expectations.

I analyzed the problem. Of the four operations involved on each piece, the second and third caused the trouble.

The second was to loosen a nut on a bolt, it being necessary to hold the bolt head. I drove a socket wrench into the wooden bench. Thus I could put the bolt head into the socket and have both hands free for loosening. This cut in half the time required.

The third operation was to turn a collar held by this bolt until it was aligned with a second collar. The first invariably was stuck with dried paint and had to be hammered into place. I made a U-shaped bracket and set the collar in it. Then I could turn the casing in the collar, which was equivalent to turning the collar itself.

Second Prize, \$10

By C. R. Mullin, Minneapolis, Minn.

IN THE newspaper office where I began as a printer's devil, the press was used long after the size of the paper had outgrown it. The capacity of the press was an eight-page paper, but 12 pages was the usual size and special editions often were much larger.

This meant that the paper had to be printed in two parts, one being inserted in the other by hand. The room was very small, so that it was seriously crowded at press time by this work. Carrying the papers into another room would have been too costly in time.

So I picked up an old tape roller and the necessary tapes around the shop and built an extension on the outlet of the press. This carried the papers to an extra table, about two feet away. As the papers came from the press with the proper edge toward the workers, two persons were able to do the work of stuffing. This required but one table.

Third Prize, \$5

By Howard W. Reid, Detroit, Mich.

EACH week our plant accumulates 1000 pounds of yarn through which are twisted strands of copper wire. To salvage this by hand cost \$13,000 a year.

I mounted two drafting rollers on a special frame. To each of these were fitted two grooved pulleys. A roller that could be moved at will was placed upon the drafting rollers. Back of the pulleys was a set of rotary rollers, fiber covered and mounted on a hollow shaft. This shaft had a grooved pulley, behind which was a sheet-iron protector with a hole directly opposite the hollow shaft. Beneath the roller mounting were the drive mechanism gears and a small motor. Web bands served for drives.

The yarn was hooked in a wire eyelet and dropped down as the other end was passed into the rotary roller and started through the drafting rollers. This kept the yarn from being tangled by the whirling of the rollers.

World's Largest Vacuum Tube Perfect Model

THE world's largest vacuum tube—a complete working model of the well known dry cell tube that brought radio within the grasp of the average American—was constructed by an electrical manufacturing concern for display purposes. With its filament lighted to full brilliance, it presents a most attractive picture. It need hardly be mentioned, however, that the electricity it consumes requires a source of current far beyond the limit of such a dry cell as is used in a radio receiver. Just try to picture the size of the radio set in which several tubes of these proportions could be operated.

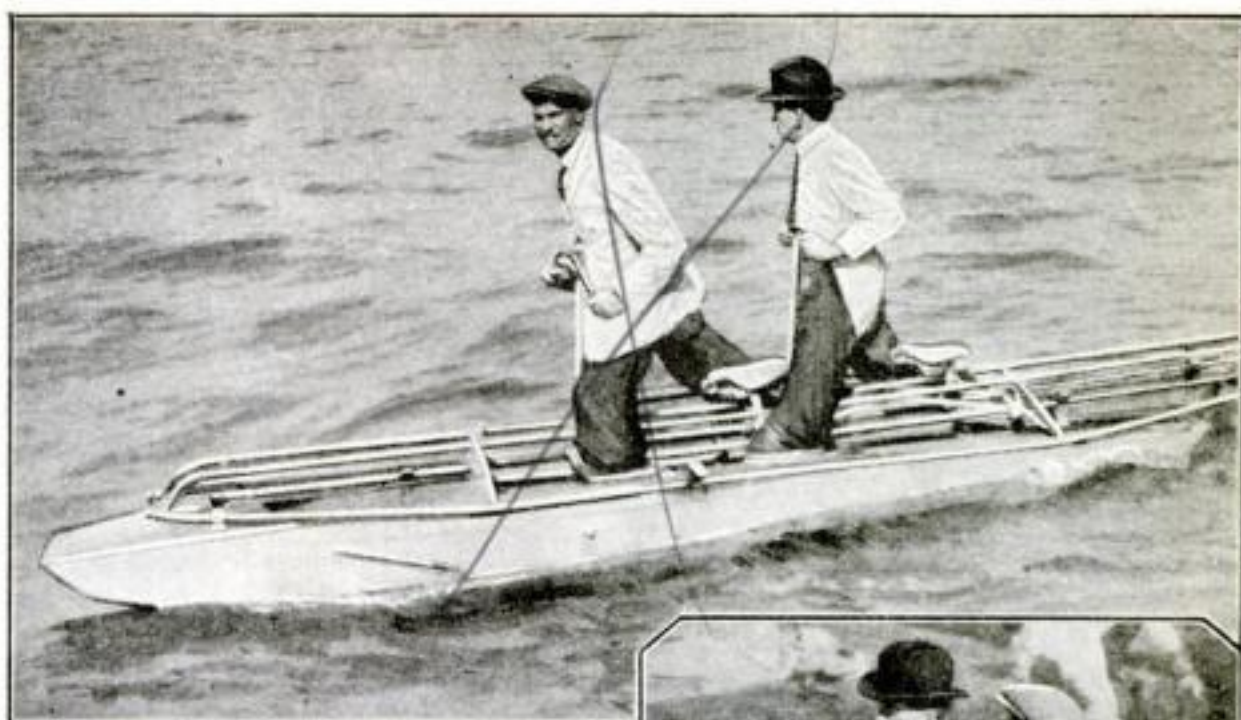


Giant model of dry cell radio tube

Doctor Says Auto Driving Makes Us Pigeon-Toed

AS A result of continual automobile driving, Americans are becoming pigeon-toed, according to the statement of Dr. Carl Hunt, of New York City, after extensive research to determine the cause of a marked tendency to "toe in" on the part of a large percentage of the population in large cities. Complaints of pains in the right foot, which are becoming common, also are attributed by him to the same cause.

"Automobile drivers are developing a new form of foot trouble that in many cases becomes actual deformity," says Dr. Hunt. "Ever since the advent of the foot accelerator, my car-driving patients, in ever increasing numbers, have complained of pains in the outer side of the middle third of the right foot, particularly when walking. In most cases I have found that with correction of the position of the foot on the accelerator, manual manipulations, simple exercises, and properly fitting shoes, the trouble has disappeared."



Brothers Hike across Bay on Water Shoes

HIKING across San Francisco Bay recently, A. N. Sheldon, inventor of ingenious water shoes that made the feat possible, with his brother scored man's latest conquest of the water.

These shoes are 10 feet long and 14 inches wide, and of pontoon construction. They are walked with much as one walks with snowshoes. A top framework prevents the pontoons from spreading sidewise, at the same time accommodating the alternation of the stride. Handlebars aid in steering the course, which, although slow, is said to be safe and certain.

The decks of the "shoe pontoons" are covered, except for four small openings just large enough for the two operators to insert their feet.

Bicycle saddles mounted on the framework enable the walkers to rest.

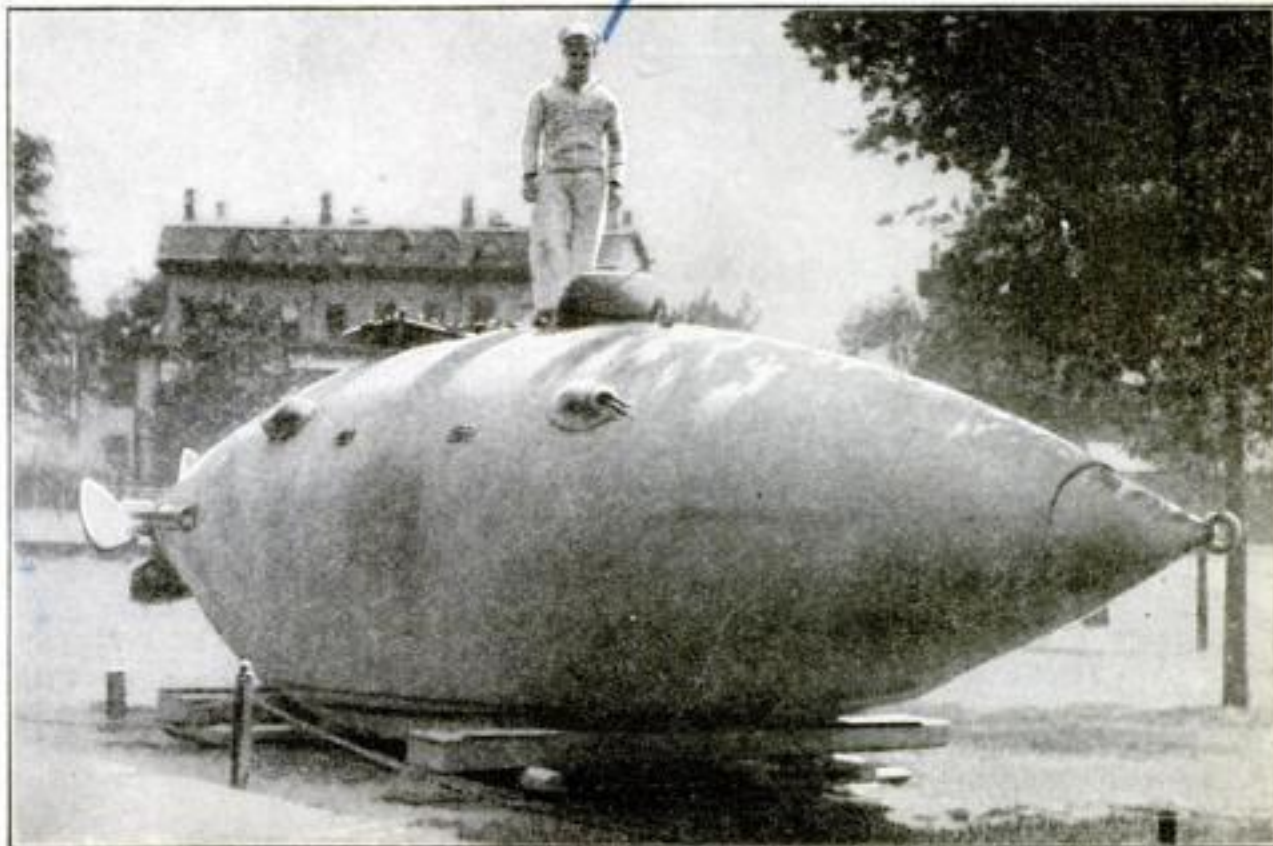


Side and front views of the water shoes

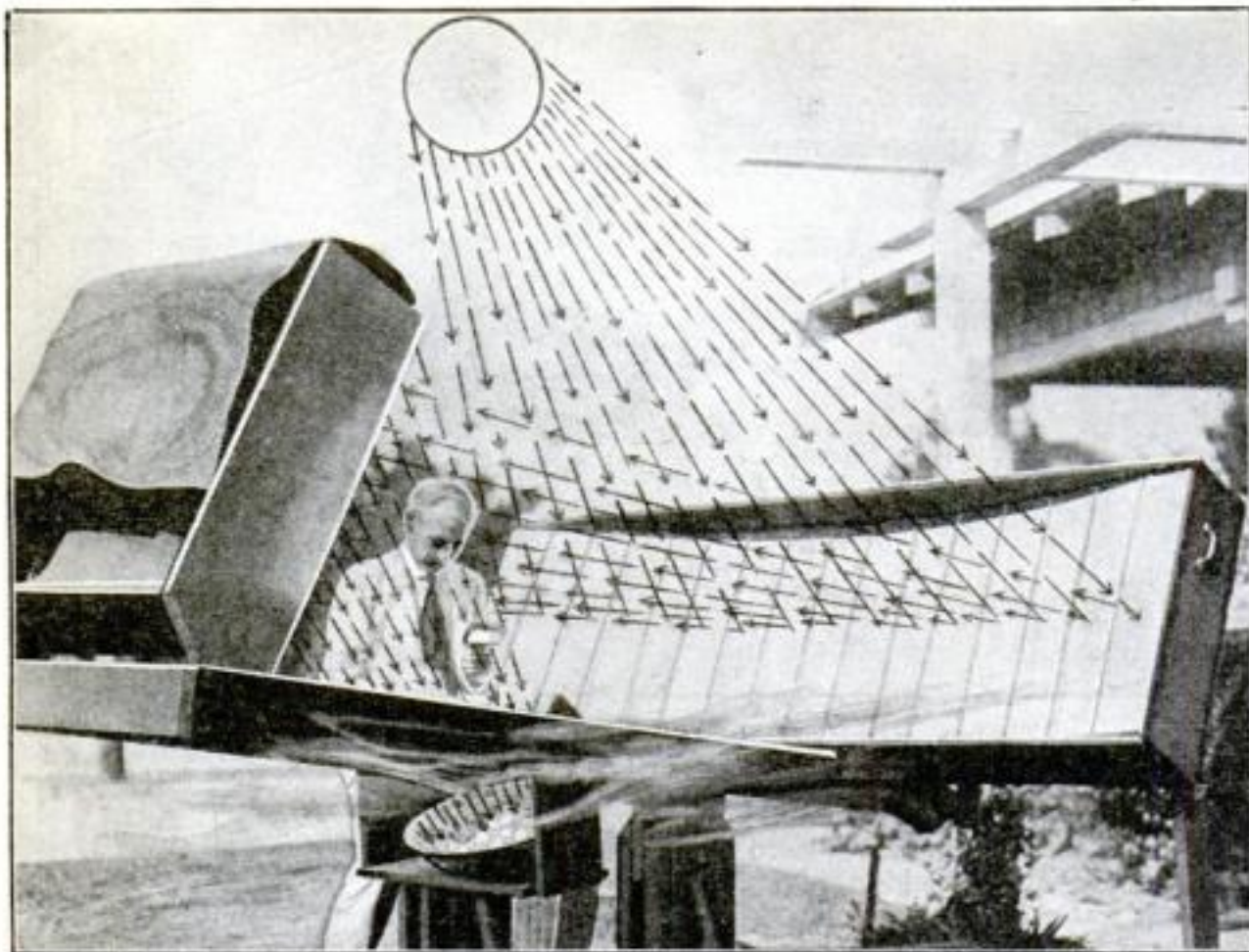
FOREFATHER OF MODERN SUBMARINES

HERE is one of the world's first submarine boats, built in 1864, by Messrs. Bushnell-Rice and Halstead of New Jersey, and now one of the relics on exhibition at the Brooklyn Navy Yard, New York.

It had a speed of four knots and was propelled by hand. A crew of 10 men was carried, although it was only 28 feet long and nine feet high. The cost was \$60,000. The first successful submarine vessel was by David Bushnell in America in 1775.



The hand-propelled submarine, built in 1864, on exhibition at the Brooklyn Navy Yard, N. Y.



CONCENTRATED SUNSHINE MELTS ORE

CONCENTRATING sunlight to an intensity sufficient to melt ore, this reflecting apparatus, perfected recently by William Thomas, Los Angeles physicist, formerly an engineer with Thomas Edison, seems to mark an advance in the attempt to harness more sun energy.

The sunlight strikes sixteen 30-inch

panes, each set at such an angle that the rays are reflected, considerably concentrated, upon another set of panes opposite. From these the rays focus on a spot six inches square.

Thus, the heat normally distributed over 24 square feet is concentrated to fall upon an area of 36 square inches.

UNDERWATER SIGNALS RESCUE BOATS

TO LOCATE and rescue lifeboats or other small craft lost from their mother ships in fog or storm, a simple underwater signaling system has been perfected. It consists of a portable direction finder for the mother ship, and a sounding device, also portable, for each small craft.

The direction finder, which is lowered into the water, is an inverted metal Y about four feet long. A rubber bulb at the end of each arm receives and transmits the signals to the ears of the listener through stethoscope binaurals.

The sounder consists of an inverted metal cup at the end of a metal rod. The cup end is submerged, and the upper end of the rod is struck with a hammer. The sound waves thus produced are said to carry several miles under water.



Above: Lowering the V-shaped direction finder into the water. The upper inset shows how signals are sent by striking a metal rod attached to a submerged sounding device. At the right: Listening to signals



Carbonic-Acid Gas Said to Fertilize Gardens

INCREASES in vegetable yields ranging from 35 to 175 per cent are said to have been achieved recently by German agricultural experts through the use of



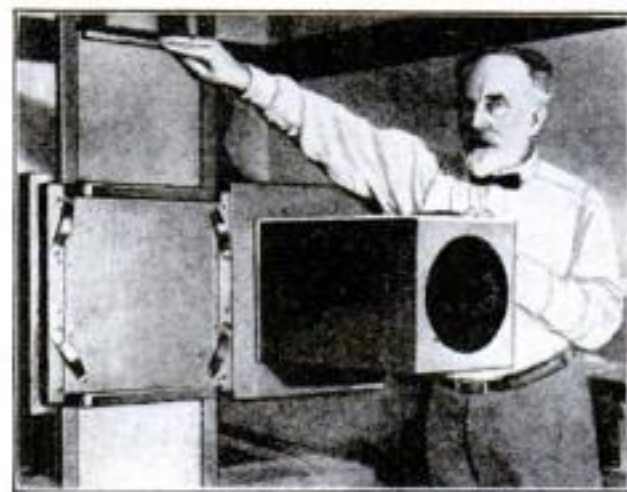
How the size of potatoes was increased by fertilizing them with carbonic-acid gas

carbonic-acid gas as a soil fertilizer.

Since carbonic-acid gas is formed in combustion, waste gas from a mine and foundry near Essen, Germany, was used in the experiments. After being purified, this gas was led through pipes with perforations to hothouses and open fields. In both cases astonishingly favorable results were reported.

Much more rapid development and a 70 per cent increase in yield are claimed to have resulted from supplying the gas to cucumbers. Tomatoes were said to be increased 275 per cent.

Largest Camera Lens Used to Photograph Stars



ONE of the world's largest cameras was made recently by the United States Bureau of Standards to photograph astronomical observations. It is six feet long, four feet wide, and 2 1/2 feet high. It uses plates 11 by 14 inches. The lens is said to be the largest photographic camera lens ever manufactured in the United States.

Ocean Currents Measured by Floating Bottles

KNOWLEDGE of the direction and speed of ocean currents is of great importance to navigators. Since it is difficult to measure these directly, the United States Hydrographic Office accomplishes it approximately by means of what are known as "bottle papers." These are small paper slips with directions for their return to the proper authorities printed in several languages. Sealed in bottles, they are given to ships' captains, and thrown overboard. On them are written the time and place they are launched. After months or years they return to Washington. One drifted nearly across the Atlantic and back.

Potato Bugs Speared to Death by Enemies

A GAINST the devastating potato bug, the United States Department of Agriculture is marshaling an army of enemy soldier bugs, popularly known as "stink bugs."

Every time a potato parasite clashes with one of these deadly antagonists, potato plants are just one bug safer. For the soldier bug usually wins. Advancing to the attack, he jabs a spearlike beak into a soft spot in his prey's armor. Barbs at the tips of the jaws keep the spear inserted. The doomed potato bug at first feigns death, then begins a frantic scrambling over obstacles to shake off its assailant. Exhaustion finally leaves the potato bug at the mercy of the soldier bug's appetite, which sates itself on the blood and juices of the victim.

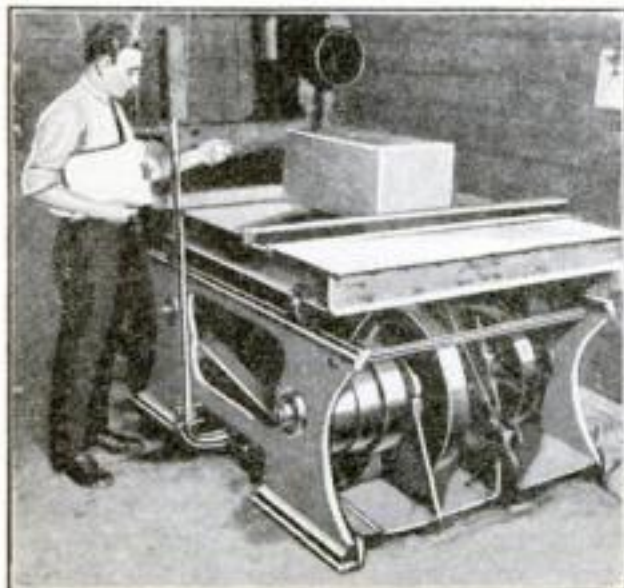


Soldier bug feasting on potato bug

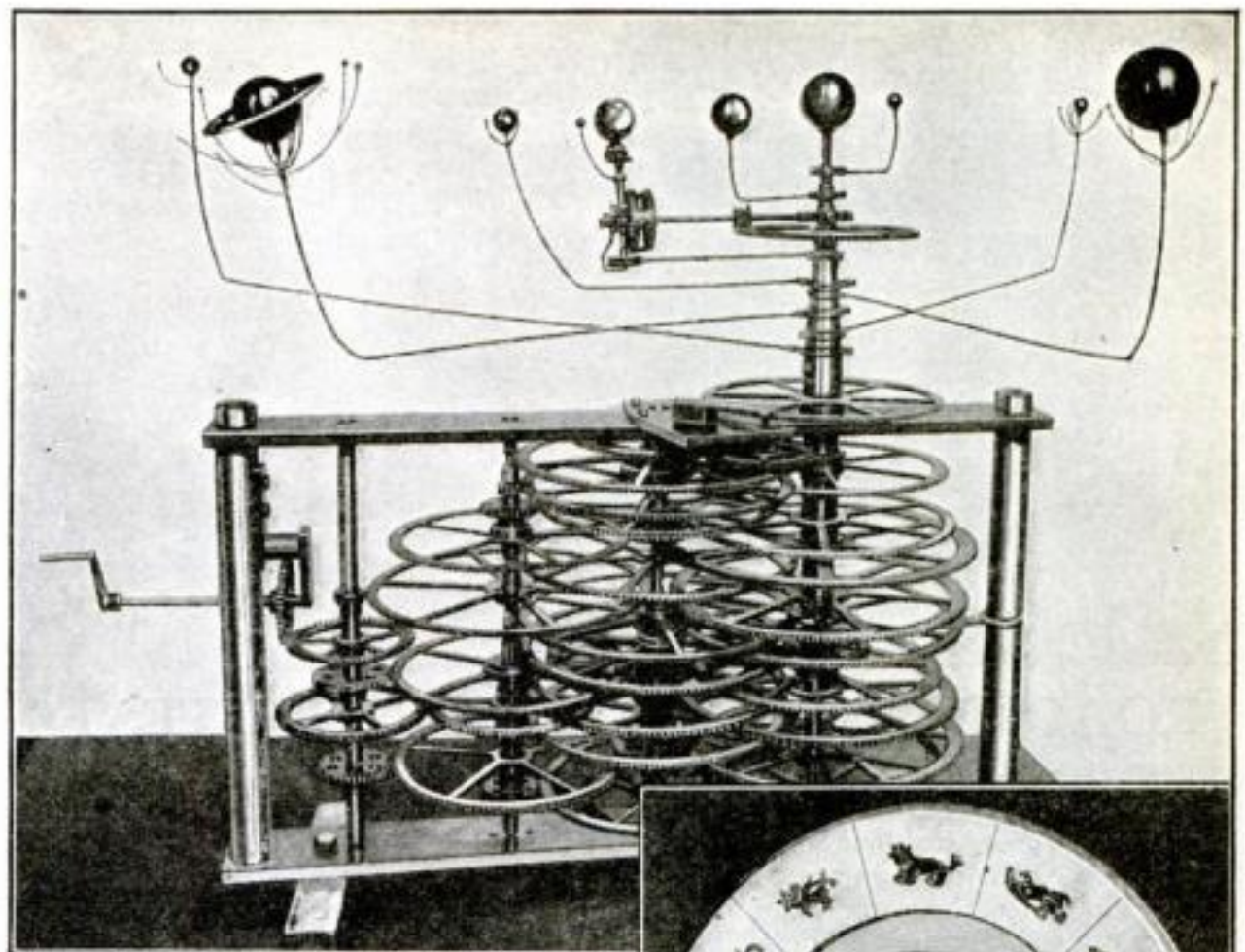
Jolting Machine Tests Strength of Boxes

SIMULATING the bumping and swaying of a moving freight car, a machine recently designed by the Forest Products Laboratory of the United States Department of Agriculture, tests the strength of box containers for merchandise in transportation.

A table to which the box being tested is attached moves backward and forward on wheels over a distance of several inches. The wheels roll on rails at each side. The shaking effect may be varied by accelerating or slowing the machine.



Testing a box on the shaking table



Clock Shows Movements of Planets and Satellites

AN AMAZINGLY intricate 10-dial astronomical clock that records minutely the movements of each planet and satellite of our solar system has been invented by Oswald Schulz of Berlin.

Since each of these bodies has a characteristic set of movements, this is an astonishing mechanical achievement. The clock has no springs and operates only while the crank shown at the side is turned. The upper illustration shows the stripped mechanism. The lower records the ecliptic rotation of the moon about the earth.



This dial shows the movement of the moon around the earth. Top: The solar clock, uncovered, showing the intricate mechanism



The inventor demonstrating his sun engine

Sun's Rays Bottled to Drive Steam Engine

BY CONVERTING the energy of sunlight into the energy of steam with an ingeniously contrived reflector, Bernard A. Grossman, a young New York physicist, believes he has found a method of bottling solar energy for use on a large scale in producing cheap power.

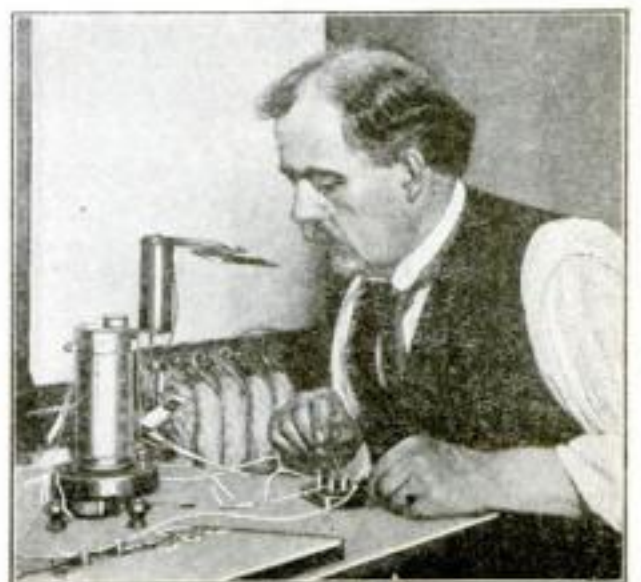
The reflector consists of a series of parabolic mirrors arranged in such a way that they concentrate sun rays upon a small boiler, producing steam. The energy thus produced, Grossman declares, may be translated into electrical energy by running a steam engine and generator.

Crime Suspects Tested by Detective Machine

GUILTY secrets are said to be bared unerringly by a delicate "third degree" apparatus invented recently by Dr. Albert Schneider of the University of California.

The suspect places the forefinger of each hand on contacts from which run minute wires to a capillary electrometer, an arrangement of glass tubing. Through one tube runs a fine thread of mercury.

Fluctuations of the mercury are said to betray the suspect.



Doctor Schneider and his crime detector



ROAD LINES SIMPLIFY BRAKE TESTS

TESTING auto brakes is made easy for the motorist by traffic authorities of Hartford, Conn. Just outside the congested area of the city, on road stretches selected because they are smooth and level, offering little possibility of collision, are painted the testing directions and white lines shown above.

The lines are 20 feet apart. The driver is to cross the first line at exactly 15 miles an hour, applying his brakes full force at the instant of crossing. If he stops at or short of the second line, his brakes are in sound order.

The lines and directions are repainted at necessary intervals.

ELECTRIC SPARKS AS FOG SIGNALS

THE blue-green flash of a sparking electric trolley, piercing a fog, inspired an idea that has developed into a powerful fog-piercing signal light as a safeguard to navigation.

R. C. Douglas, a San Francisco jewelry salesman, is the inventor who saw the flash and who realized the possibility of using quickly drawn out electric sparks for effective fog-signal lights. Today the results of his ingenuity and patience are found on San Francisco ferries and pier-heads, guiding ships through the fogs. The lights are said to penetrate dense fog more than 1000 feet beyond the reach of the eye, locating passing vessels.

A motor-driven gear mechanism in a hooded space at the top of the light raises and lowers a thick electrode upon the up-turned tip of another electrode. These two electrodes form the make-and-break point of a 110-volt electric circuit. The periodically formed gap is drawn out or widened two or three inches as the current

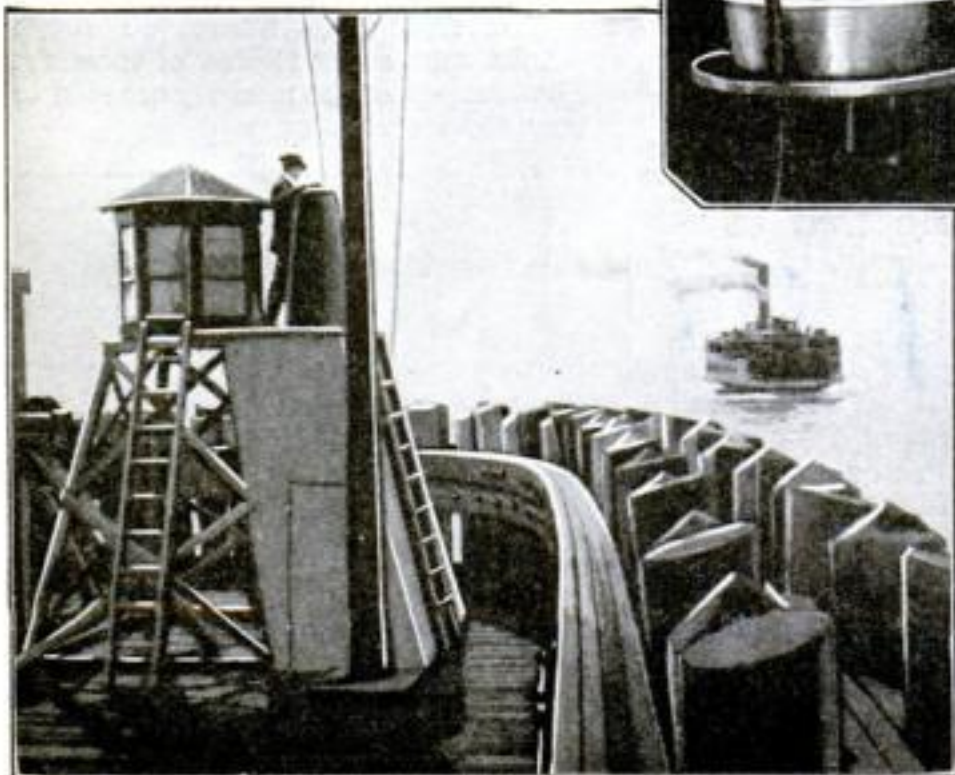
is leaping it. The flaming arc becomes remarkably active as it seeks to fill the widening space, simultaneously creating a penetrating, flashing fog light.

Douglas is continuing experiments with his invention, in an effort to increase still further the intensity of the light and thereby extend its usefulness.



Above: The inventor, with eyes protected by mask and goggles, experimenting with his new fog signal light to increase the intensity of electric flashes

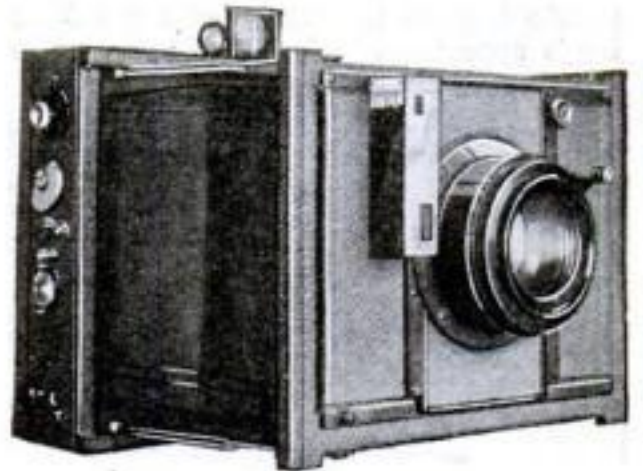
At the left: One of the lights set up on a pierhead at San Francisco to guide ferry-boats and other craft during heavy fogs



Camera Range Finder for Sharper Photographs

A PHOTOGRAPHIC range finder, using the principle that served gunners in the Great War, has been perfected in England. It is claimed to insure sharp photographs under favorable light conditions irrespective of the size of the camera lens aperture.

The invention is contained in a small metal box three inches high and seven eighths of an inch square, compact enough for the vest pocket, yet easily attached to a camera. Looking into the finder through the top aperture, the photographer sees two misplaced halves of an image, like those in the lower illustration. An adjusting



Above: The range finder attached to a camera. Below: The reflected image of a distant dirigible. Range is determined by bringing the halves of the image together



screw at the side of the finder is manipulated to justify the halves. The distance of the object from the camera then can be read off on a scale and the camera focused accordingly.

Within the finder are two mirrors, one above the other. The bottom mirror is fixed, while a smaller one at the top is movable, and is adjusted by the screw. Each mirror reflects an image of a portion of the object to be photographed. If the mirrors are parallel, the two reflections do not fit together.

By turning the adjusting screw until the top mirror is at the correct angle to make the images fit, a pointer records the exact distance of the object that is being photographed.

Corrugated Blade Slices Potatoes for Frying

APPETIZING latticed potatoes for frying — potatoes cut in thin corrugated slices like the two shown in the illustration — can be made speedily with a handy cutter that rests on the top of the kitchen table. After the potatoes are peeled, they are forced with quick strokes against a sharp, corrugated cutting blade.



Fishing Gun Casts Line without a Rod

MOTORISTS, campers, and hikers who may want to fish, but who do not wish to include a more or less cumbersome rod in their equipment, may enjoy the sport notwithstanding, through the invention of a rodless casting reel that has just been



put on the market by a New York manufacturer. This may be described as a fishing gun containing a spring that shoots the line from the reel when a trigger is pressed.

The fish may be played from the reel as with a rod. Accurate casting is possible from the shores of bays, lakes, or streams or into the surf, the makers declare.

The device is especially useful for those who desire to fish from boats. It weighs 19 ounces, is 9½ inches long, and has a capacity of 80 yards of line. The aluminum handle is hollow to permit the storing of bobbin, sinker, flies, and hooks. If desired, a rod may be used.

Shoe Shining Made Easier by Portable Cabinet

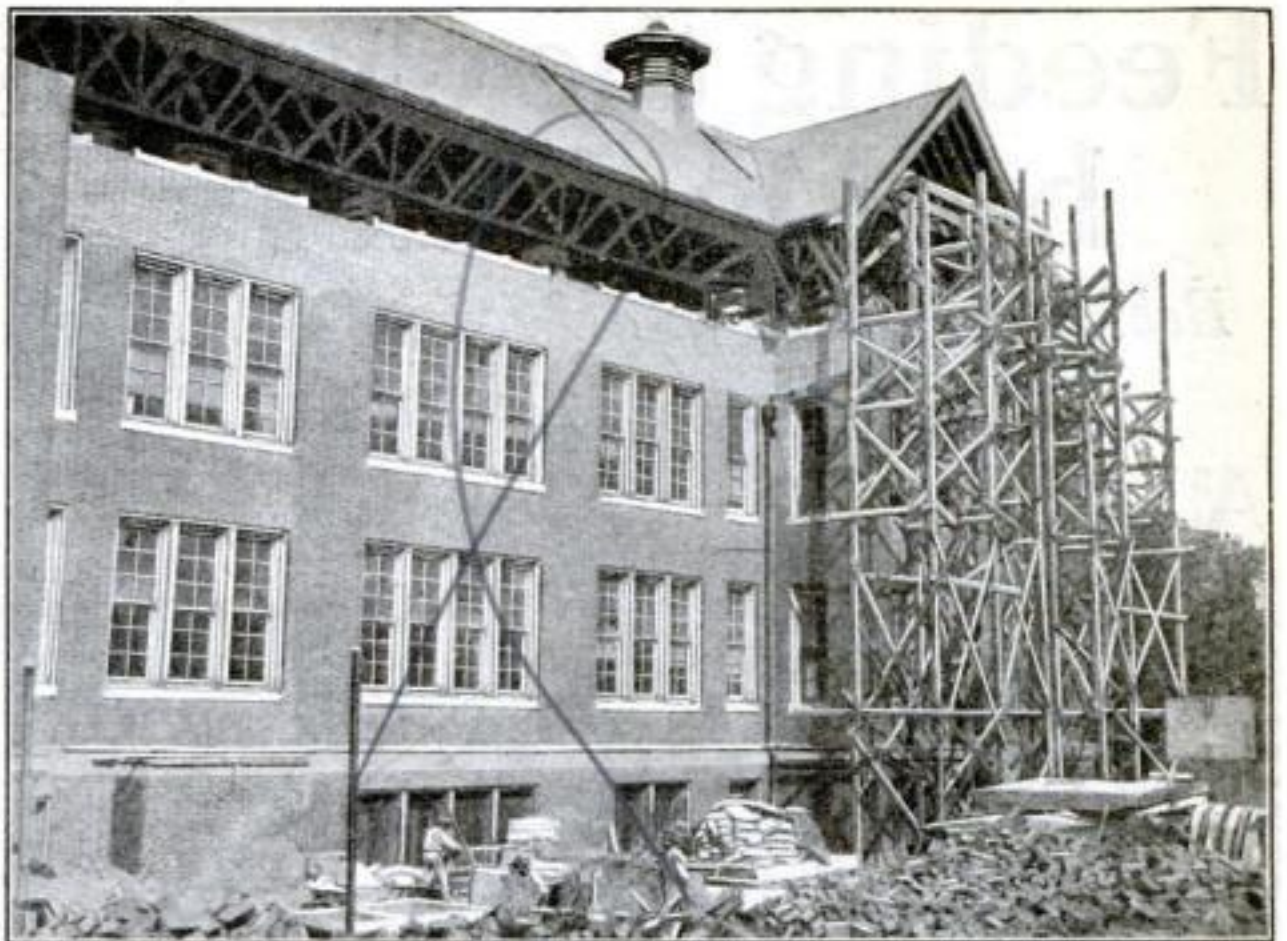
THE new portable shoe-shining cabinet shown below has an inclined corrugated rubber rest surface for the foot, a polish container that swings out to a handy position, a two-headed dauber brush and a double wool pusher with a reversible leatherette to protect the hands.

The cabinet is opened from the side by unlatching a simple catch. Four rubber feet on the bottom prevent scratching the floor.

One of the chief advantages of the outfit is its compactness. Nearly every person has used one of the old-time, clumsy shoe boxes that was about the size of a small chair and always in the way wherever it was placed. The new box, when not in use, can be put out of sight under a table or in a closet.



The outfit, showing compact cabinet



RAISE SCHOOL ROOF TO ADD A FLOOR

FOR centuries houses have been expanded by horizontal extensions. But now a schoolhouse in Washington, D. C., is being expanded upward. The entire roof, 150 feet by 75 feet, of the two-story

Thompson grade school, has been jacked up 12 feet to permit the building of a third floor.

The plan is said to have proved most practicable and economical.



New Rustless Mailboxes Made of Brass

TO RESIST the destructive, rust-producing effects of salt-tinged air, brass mailboxes are being introduced in a number of coast cities. Where such air is said to destroy the usual steel box within three years, the new brass receptacles are claimed to be immune to its action.

This resistant quality of brass makes it unnecessary to paint the new boxes the familiar green.

The photograph shows New York's first brass box, on Broadway near Wall Street, being initiated.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.

Electric Hammer Has Single Moving Part

AN ELECTRIC hammer with only one moving part has been designed for use by mechanics, builders, and manufacturers. The power tool will drill a one-inch hole three inches deep in concrete in one minute, it is claimed, and can be operated on slightly less current than would be required for an electric iron. Alternating current is necessary.

The hammer strikes 60 blows a second while the operator pulls a trigger. The single moving part is a hardened steel hammer that moves back and forth within a bronze barrel.

At each end of the barrel is a coil of wire. These coils alternately become temporary magnets as the alternating current passes through them, driving and withdrawing the hammer.



Using the electric hammer as a riveter

Feeding the Crowds by Machinery

Behind the Scenes in a Modern Restaurant

By Edward Woodward

AS YOU have sat in one of our great modern restaurants or hotel dining-rooms during the crowded lunch hour, have you not marveled at the apparent ease and swiftness with which the wants of hungry hundreds are served—all at once? On every table, beside every place, are the inevitable bread and butter. Who bakes the hundreds of loaves? Who cuts the thousands of slices? Nearly every one has ordered potatoes. Who is the galley boy that peels them?

The answer is—machinery. Mechanical science has replaced hand labor in modern restaurant kitchens, just as it is replacing drudgery in the modern American home.

Consider the single item of bread in a restaurant that feeds, say, 400 persons at one time. You can imagine what an army of bread slicers would be required to serve such a crowd quickly. Yet a machine operated in large modern restaurants cuts 200 slices a minute—or a slice for every one of the 400 in two minutes! This electrical device takes loaves 24 inches long and cuts them with such nicety that all slices are of exactly the same thickness.

Bread-Making Is Automatic

And while the bread is being sliced, another machine cuts dozens of little squares of butter at a single pressing. In fact, a remarkable apparatus recently invented for use where large numbers of sandwiches are required, not only slices the bread, but neatly butters each slice in the same operation!

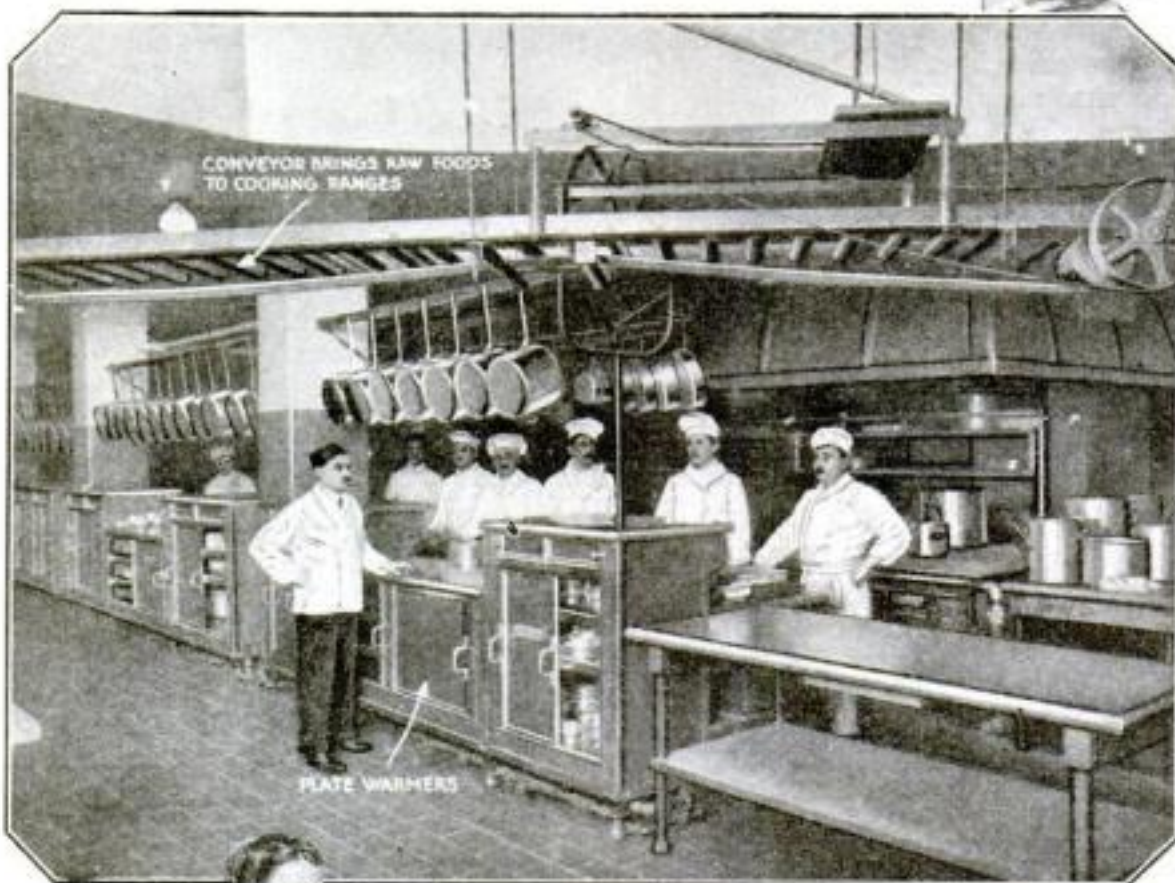
In the most improved bread-making equipment the entire process is automatic from the time the dough is prepared in the kitchen. First, a divider and scale mechanism weighs and cuts the dough to the proper size. Another machine then rounds the dough and passes it on to a third apparatus, which kneads it until it is light and fluffy. A molder gives the dough its final shape, and it is ready for the ovens.

The latest automatic electric baking apparatus has an output of from 1600 to 3200 loaves an hour, yet requires only

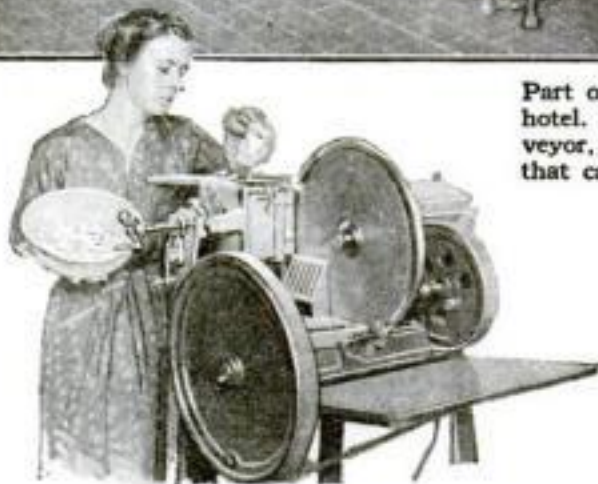
two attendants to operate it. Here the science of baking becomes simply a matter of timing. When one loaf is baked, all are baked, and all are uniform in quality. This is made possible by automatic temperature control.

Not so many years ago, breakfast—the regulation American morning meal of cereal, eggs, toast, and coffee—was one of the greatest problems of the restaurant owner. Today, machinery has made it one of the simplest. Toast, that formerly took a long time to prepare and required much individual attention, now is made at the rate of a dozen pieces at a time on an electric grill that automatically turns the pieces when they are brown, and toasts both sides evenly. Eggs, that must be boiled an exact number of minutes and half minutes, according to the individual taste of each patron, now can be cooked in a machine that dips them in boiling water, times them, and automatically takes them out of the water when their time is up.

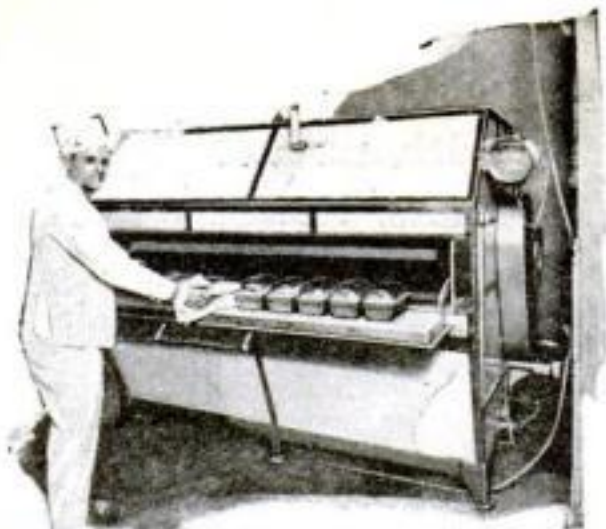
Coffee can be made 40 gallons at a time—enough to supply 600 diners. Cream for the coffee is measured automatically by a machine that pours it



Part of the kitchen in a New York hotel. Note the power-driven conveyor, above the heads of the chefs, that carries raw foods to the ranges



At the left is shown a remarkable new machine that not only slices loaves of bread, but butters each slice in the same swift operation



One of the newest types of automatic electric bake oven, in which bread baking is reduced to simple timing control

into little individual pitchers, an ounce at a time.

At every meal, potatoes, like bread, are demanded in enormous quantities. An automatic machine peels three pecks of potatoes in three quarters of a minute. This apparatus is a great cylinder, the bottom of which is a revolving disk. The interior is lined with special concrete facing. As the potatoes are whirled around swiftly in the cylinder, they are knocked against the sides. The impact removes the skins in small flakes without bruising the potatoes. A small stream of water plays continually on the vegetables, washing away the residue. Carrots, turnips, onions, and other vegetables are prepared for the pot by the same type of machine.

For nearly every different way of serving potatoes there is a special machine. A motorized masher that operates like an egg-beater whips and mashes them at the rate of a peck a minute. Another machine slices the potatoes in uniform pieces for French frying.

Two Hundred Cakes a Minute

Cakes, pies, and other pastry that once tried the skill of every cook, can be turned out by the dozens at the press of a button. An automatic sponge-cake beater will beat 30 quarts of cake batter to feathery consistency. And when the electric oven has baked the batter to an even, appetizing brown, another machine drops the cakes out at the rate of 200 cakes a minute!

Pie crust is made by a motorized roller. And when the pie is in the dish, before it is put in the oven, a machine presses the rim of the crust down evenly and clips off the extra dough, while still another machine marks and crimps it.

These are just a few of the marvels of scientific cookery as it is practised today. Others are shown on the opposite page.



Above is a typical view in a great modern restaurant during the lunch hour. To feed these hundreds of persons all at one time requires not only ingenious automatic machines that turn out food in large quantities, but also high-speed conveyor systems to carry food and dishes from the kitchens to the immense dining room

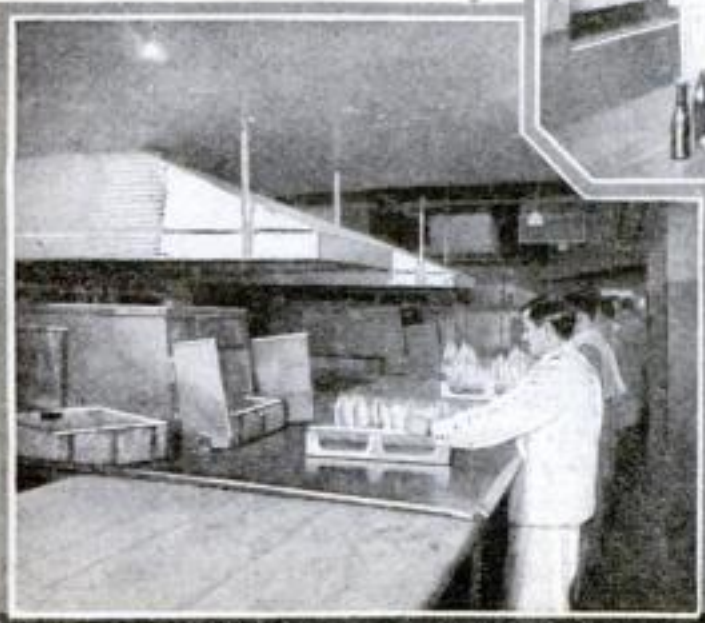


At the left is the soup kitchen of an up-to-date restaurant. The soup is cooked in a battery of enormous kettles, where the heat is controlled automatically, and is drawn off through spigots at the bottom of the kettles into serving buckets. These kettles hold enough soup to feed a thousand

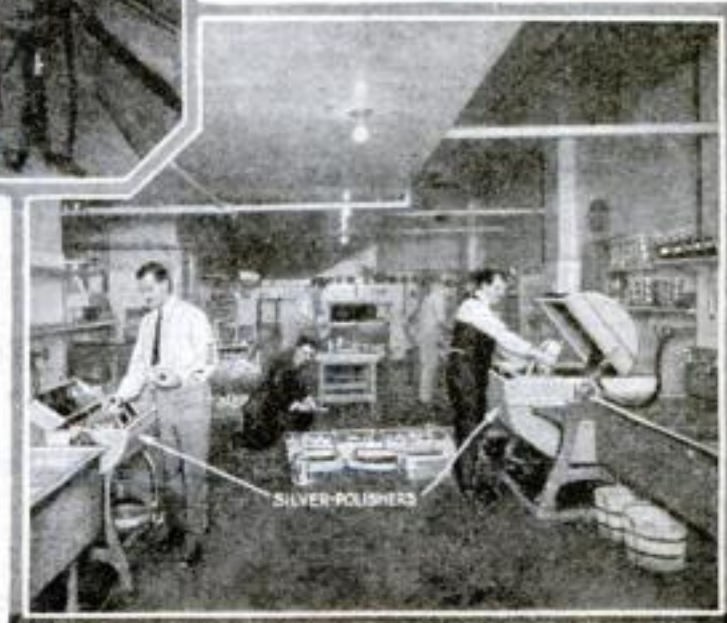
Below is a new heavy-duty dish-washing machine, said to have a capacity of 12,000 pieces an hour. It does the work of an army of cleaners. The soiled dishes, in racks, are inserted in the machine. In a few seconds they are thoroughly scoured



Below: Silver-cleaning apparatus. The silver is cleaned by burnishing. It is immersed in a bath of small steel particles—highly polished balls and pins—that reach the otherwise inaccessible parts. These polish without wearing away the plate



To save time and economize in space, elevators and other conveying apparatus are employed to carry food from kitchens to service- and dining-rooms on other floors. This kind of machinery has made it possible to prepare the food on several floors and to serve it in the dining-room without the slightest loss of time



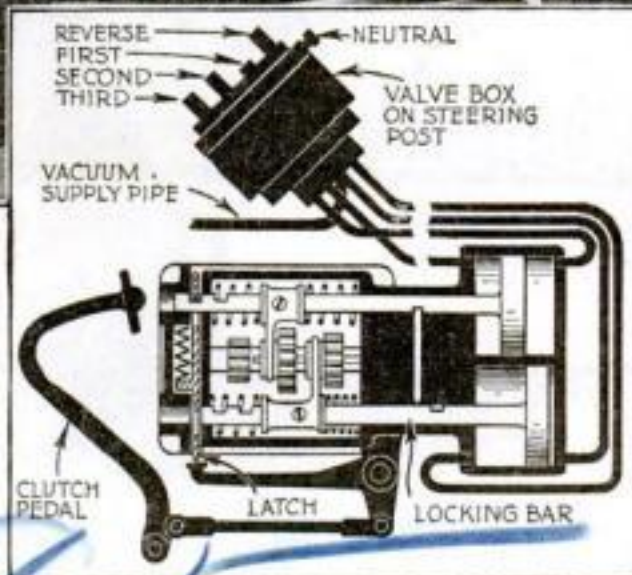
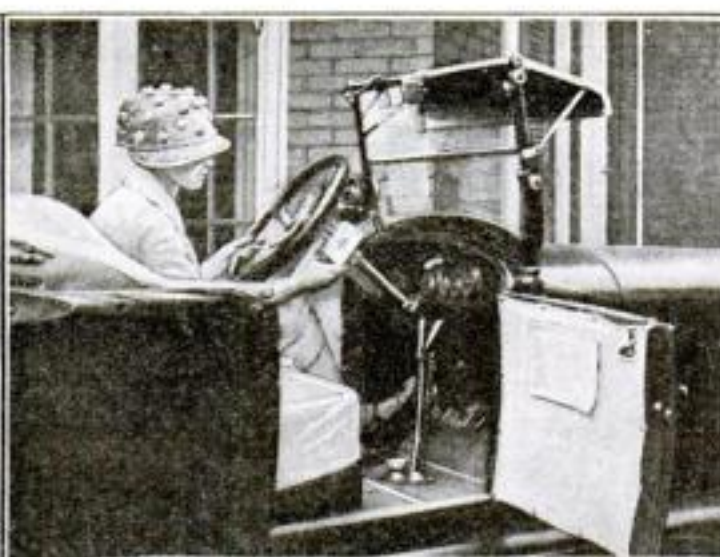
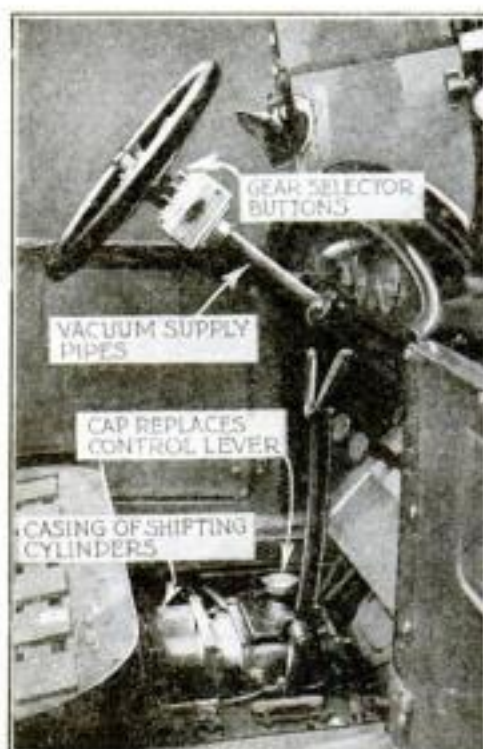
ENGINE SUPPLIES VACUUM FOR AUTOMATIC GEARSHIFT

AN AUTO-MATIC gearshift, operated by vacuum supplied by the engine and regulated by buttons at the rim of the steering gear, has been developed by a Pittsburgh manufacturer and recently offered to motorists.

Unlike electric shifts and other substitutes for the standard lever, this new method requires no additional power installation, beyond that already supplied by the motor. It is said to be quick, safe, and easy of operation, insuring proper meshing of gears under any condition of driving and permitting a selective shift.

A pipe connected with the intake manifold supplies the vacuum by which the shifts are made. This pipe is connected with a series of cylinders, corresponding to first, second, third, and reverse gears. To shift gears, the operator presses one of a set of buttons at the steering wheel, corresponding to the gear desired. This button operates a valve that causes the motor to withdraw the air from the cylinder that controls the movements of the gear. When the clutch pedal is pushed to the floor and released, the gear mechanism is unlocked and the desired shift made.

By the vacuum control system it is possible to prepare for anticipated shifts in advance. Then movement of the clutch pedal will make the necessary shift without the need of removing the hands from



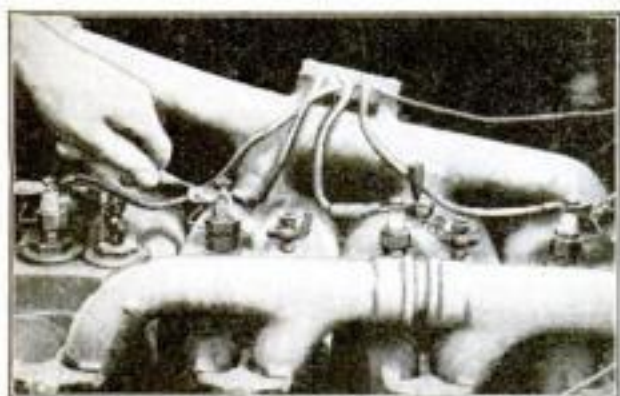
Above: The driver's control mechanism of the vacuum gearshift, showing selector buttons for first, second, third, reverse, and neutral in a valve box close to the wheel. The layout of the entire vacuum system is shown in the diagram.

the wheel, which means additional safety.

When the motor is idling, sufficient power is generated, it is said, to permit the shift to be made from neutral to first speed with surety, even on cold days when the lubricant in the transmission case is stiff and sluggish. By partly engaging the clutch after one shift has been prepared, and then setting the button for the next shift, it is possible to engage the clutch and then pass at once to the next speed by pressing the pedal and engaging again.

instrument board, steering post, or floor controls. A one-inch hole in the flooring to permit the entrance of the pipe from the valve box is the only alteration necessary. The gear lever is of course removed, and in its place is installed a polished cap that may be removed to lubricate the transmission.

The manufacturers assert the vacuum gear control costs nothing to operate, since the power required to operate it is present in the automobile engine.



Cut-Outs Test Spark Plugs

WHEN an auto engine runs unevenly, the average motorist short circuits the spark plugs successively with a screwdriver to locate the faulty cylinder. But if more than one misfires, the "shorting" of one plug at a time may not sufficiently slacken the rotation to locate the fault.

G. C. Beck, of Spokane, Wash., has devised wooden-handled wire levers that can be attached permanently to the spark plugs situated beneath the ignition wires.

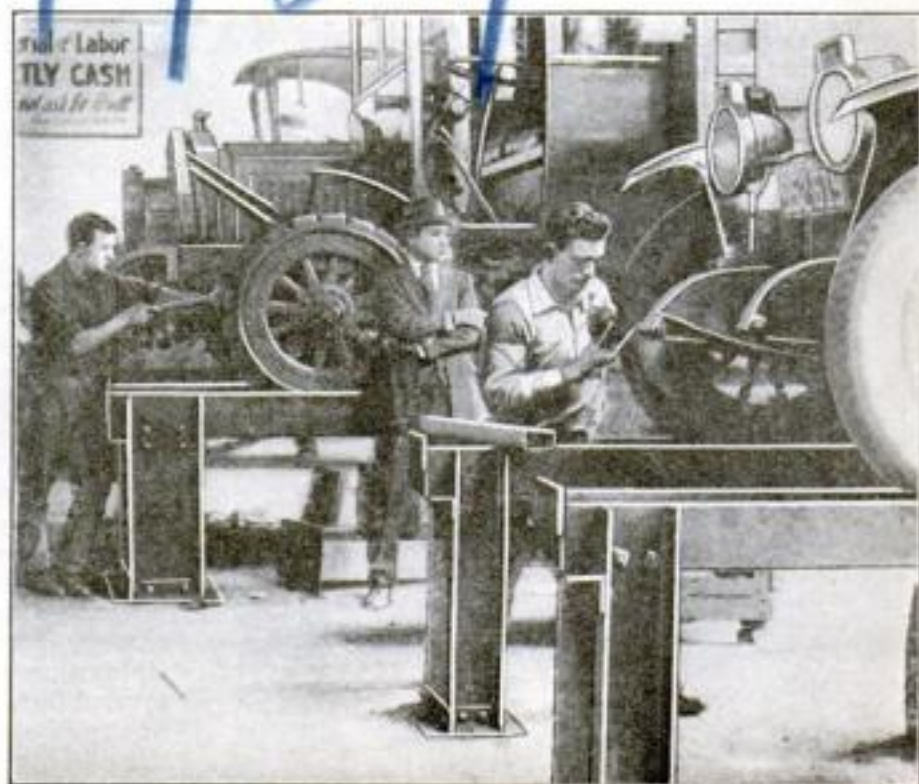
When all but one of the levers are moved to bring the ends in contact with the iron shells, but one cylinder can fire. Mr. Beck says that if all cylinders are thus tested independently, the dead cylinders are certain to be discovered.

AUTO DRYDOCK SPEEDS REPAIR WORK

TO ACCOMPLISH greater speed in automobile repair work, as well as greater convenience for mechanics and motorists alike, a garage owner in Boston, Mass., has equipped his shop with an ingenious automobile drydock built of steel channel beams. This innovation makes it possible for mechanics to make repairs—such as mending broken springs—beneath the body of the car without the use of jacks.

The drydock is built of channel beams riveted and bolted to form a series of runways. The beams are spaced so that automobile wheels will fit into the channels and run along them. The arrangement is such that automo-

biles in need of repair enter the "drydock" from the street level, and run along the elevated tracks. In the repair shop they are elevated about three feet.



Channel beams form "drydock" and runway for automobiles

When Radiators Freeze and Engines Balk

There's a Sure-Fire Way to Keep Your Car Running Smoothly in Winter

By F. A. Platte

Instructor, Department of Physics,
Columbia University

WINTER—frozen radiators and balky engines. Nearly every motorist thinks of them together. But why should the pleasure of automobile driving vanish with the migrating birds? Is there no sure-fire preventive for the frozen radiator and the cracked water jacket? Can't we count always on hearing the purr of the engine after a single push on the self-starter?

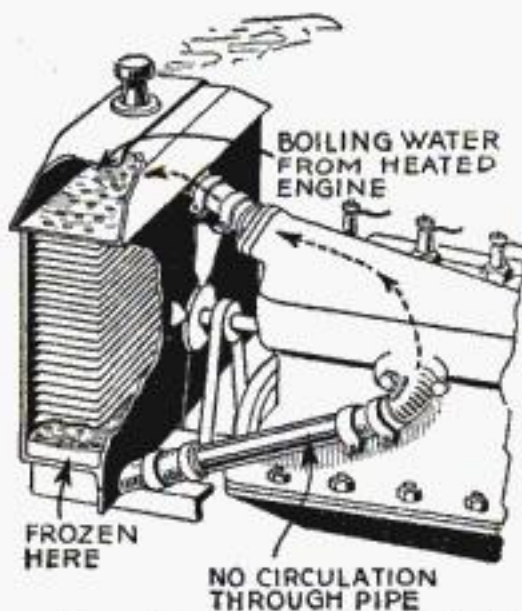
For every car there is an effective way to avoid the most common of wintertime woes. First, let us consider the cooling system and its troubles. All freezing can be avoided if a proper mixture is maintained in the radiator and its connections. There are many varieties of anti-freezing mixtures that can be bought or made. Some are effective, others injurious; but it is safe to say that denatured alcohol mixed with water is the most successful for general purposes.

Find Lowest Winter Temperature

Denatured alcohol will not freeze until the temperature falls to 200 degrees below zero. A mixture of water and alcohol will freeze at a temperature correspondingly higher, depending on the amount of water used. Find out how low the thermometer usually falls where you live; then consult the following table to determine what ratio of alcohol to water you should use:

Temperature	Alcohol	Water	Specific Gravity
18° F.	1 part	5 ² / ₃ parts	.9820
12°	1	3 ¹ / ₂	.9740
0°	1	2 ¹ / ₃	.9625
0° below	1	2	.9578
20° below	1	1 ¹ / ₂	.9475

Before filling, inspect the radiator and joints for leaks. Repair



"I wonder what can be the trouble?" asked the puzzled winter driver, as his engine balks and he sees steam coming from his radiator. Without warning, the water passing through the cooling coils of the radiator has frozen at the bottom, cutting off circulation in the cooling system. Meanwhile the heat from the engine boils the impounded water at the top of the radiator, as shown in the diagram

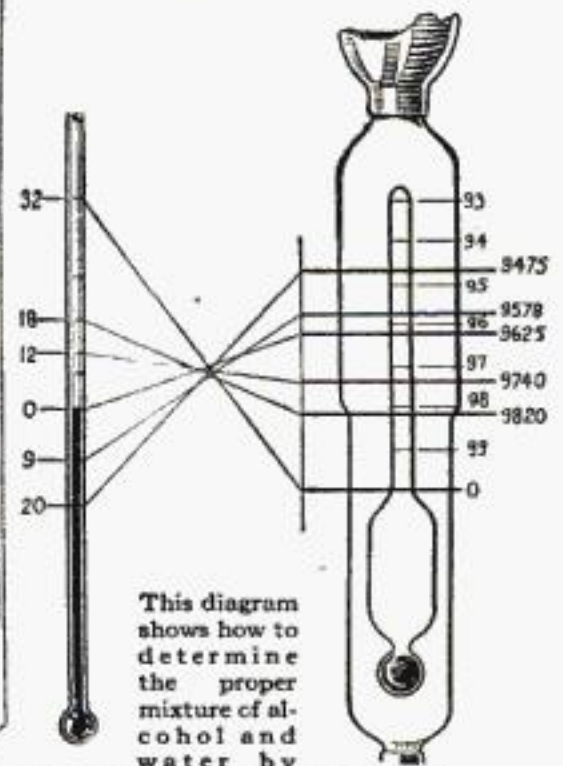
these and find out how much liquid the system will hold. Fill up the radiator with water, then drain it off through the petcock at the bottom. Measure the drained water with a quart measure and remember the quantity as the figure to be used as long as you operate the car. The average content of radiator and water jacket is 35 quarts. This would require 15 quarts of alcohol in a locality where the lowest temperature is zero.

Now close the petcock, pour denatured alcohol into the radiator and fill it up with water. Of course the mixture will not last indefinitely. The radiator should be inspected and filled every day just as in the summer. Some motorists mix water and alcohol in the original proportions and continue to fill with that mixture. This is wrong, for it will cause the radiator to contain nearly all water in a short time. This is due to the fact that

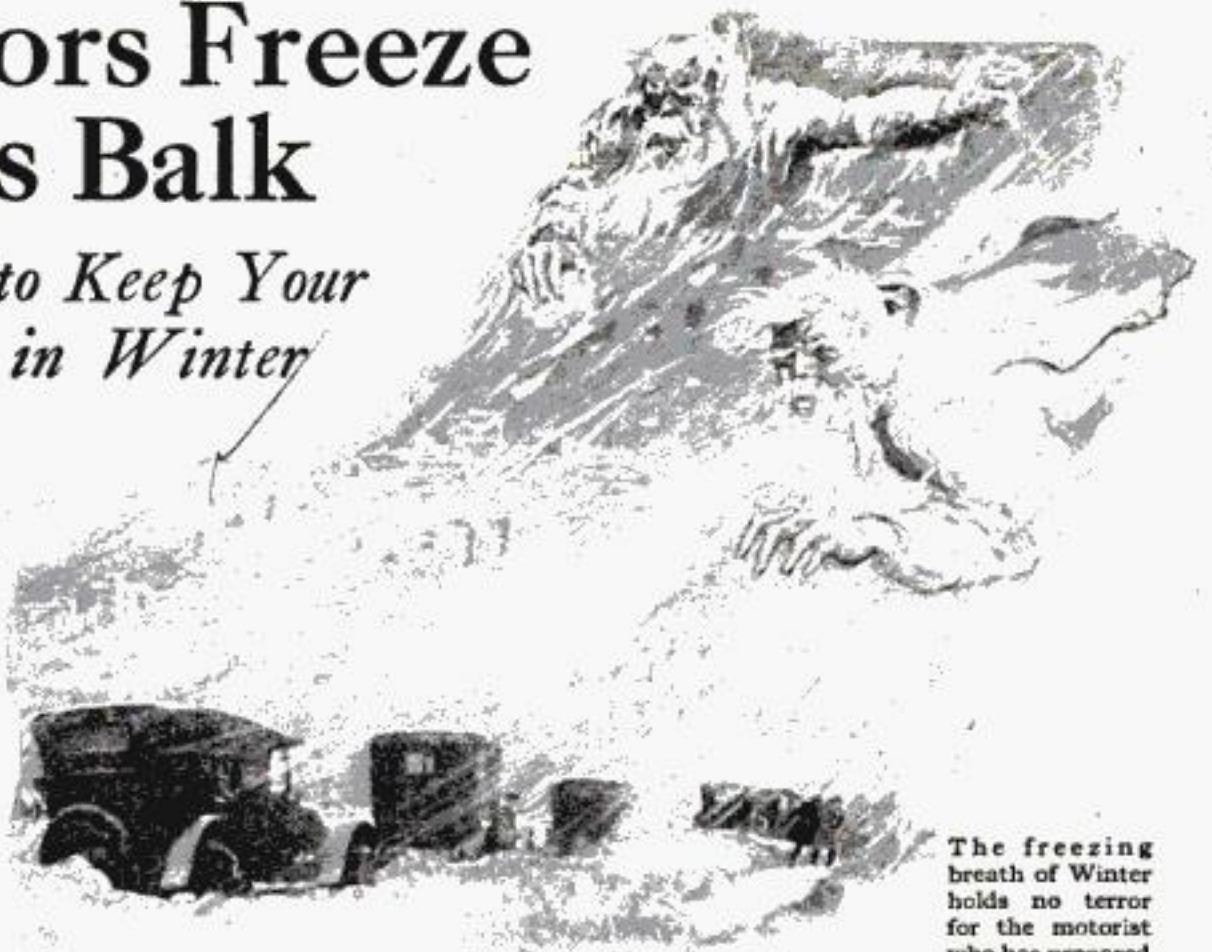
alcohol boils away at a lower temperature than water, namely 171 degrees. If you find that you require the addition of a quart of liquid, it may be that most of the replacement must be alcohol.

A sure method of making additions correctly is to rely only on a hydrometer, an instrument that determines the specific gravity of liquids lighter than water. When inserted in the mixture of the radiator it will tell exactly the proportions of water and alcohol. In making readings, the temperature of the mixture should be about 60 degrees; otherwise the hydrometer will not register correctly. A method often satisfactorily employed is to make replacements with a mixture containing 75 per cent alcohol. In general, this will keep the alcohol content high enough.

Wood alcohol should not be used. It is harmful to the rubber and metal connections and its fumes injure the eyes. Grain alcohol is effective but too



This diagram shows how to determine the proper mixture of alcohol and water by means of the hydrometer (at right). Tracing the lines from thermometer readings (at left) gives the correct hydrometer readings in specific gravity



The freezing breath of Winter holds no terror for the motorist who has prepared his automobile for the lowest temperatures

expensive. All the alcohols give off offensive fumes when heated, but denatured alcohol fumes are mild and non-injurious.

In very cold climates it may be advisable to use a half and half mixture of glycerin and denatured alcohol. Glycerin does not evaporate so easily as alcohol. Its disadvantage is that it is difficult to remove in the spring when changing back to water.

Don't Use Kerosene

Kerosene sometimes is used as an anti-freeze liquid, but it is not satisfactory. When heated, it becomes dangerous. It boils away rapidly and gives off an offensive odor.

Calcium chlorid will stop freezing, but it will also stop the car; for it eats away the solder and copper or aluminum in the radiators. Ordinary salt can be used in an emergency.

In addition there are patented products on the market for stopping freezing. Many of these are good and will work as well as the denatured alcohol mixture recommended. Radiator covers will help also, by protecting the liquid from wintry blasts.

If your radiator has been taken care of according to the directions given, the next consideration should be that of quick starting. Too often, when you turn on the ignition and step on the self starter, the engine fails to budge. What is wrong? The trouble usually is that cold gasoline vapor from the carbureter strikes the cold walls of the cylinders, condenses, and forms puddles on top of the piston. This liquid cannot explode. No matter how often you shoot a spark through the plug, your engine will remain dead.

The easiest way to avoid this difficulty, of course, is to keep the car warm in a heated garage. But you cannot take the garage along when you go downtown and park your car at the curb. Undoubtedly the simplest way to assure quick starting under all circumstances is to prime the engine with some fuel that is lighter, more volatile, and more easily fired than ordinary gasoline.

Priming Fuels

Among the satisfactory fuels is a high grade gasoline such as used to be available as motor fuel in the days before refiners lowered the grade of gasoline. This high-test fuel may be obtained from drug stores or from the large oil companies. Another priming fluid that manufacturers have been producing in recent months is known as "petroleum ether," differing little from high test gasoline.

The easiest and most convenient method of priming is to install an equipment

consisting of a small airtight tank holding about a quart of priming fluid. From this tank a pipe leads to the inlet manifold. Another pipe leads to a control pump on the dash. Operating the control injects a small amount of the priming

fuel into the inlet manifold. From there it is sucked into the combustion chambers, firing at the first spark.

Another method is to keep a small bottle of petroleum ether and a priming gun in your toolkit. When the engine refuses to respond, shoot a few drops into each cylinder through the petcocks near the spark plugs, or into the float chamber of the carburetor. You will be surprised at the effect. In temperate climates a mixture of half ether and half benzine will be found to work well.

Ether Aids Starting

Some motorists add three ounces of ether to every five gallons of gasoline in the tank. This will aid in obtaining proper vaporization for starting. To aid further in vaporization it is well to open the throttle when turning off the ignition in stopping the car. In this way the vapors will be drawn into the

cylinders without burning, remaining there until you are ready to start again. Also cover up the hood of the car when you put it into the garage in the evening. Enough heat will be retained in the engine to prevent the cylinders and carburetor from becoming too cold.

In spite of all of these precautions, trouble occasionally is encountered in starting, by reason of the fact that gasoline will not pass through the carburetor. This usually is because a drop of water has frozen over the opening leading into the bowl of the carburetor. Even though the gasoline used may have contained no water, the cold bowl of the carburetor may condense enough water vapor from the air within to cause a drop to accumulate. Make an inspection for this trouble before you decide to tear the engine apart.

Since warm gasoline will assist greatly in starting, many means have been resorted to in order to heat the carburetor. Electric heaters, reflectors or even electric irons have been used successfully to accomplish this result.

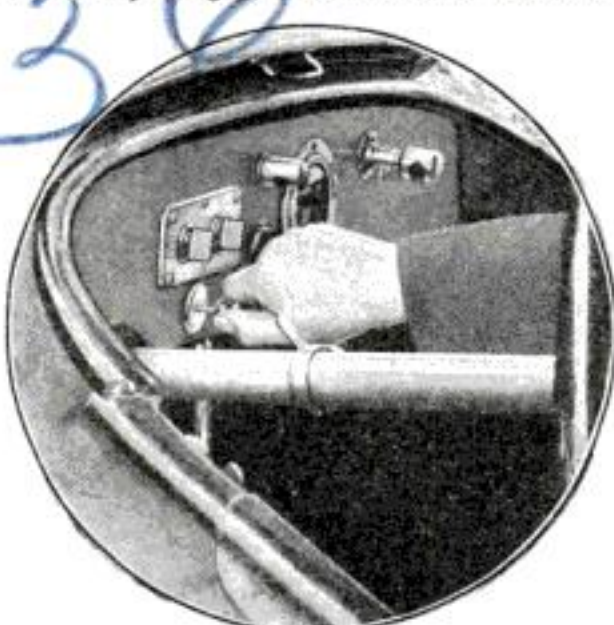
Electric heaters are available on the market to keep the carburetor and the manifold warm while the engine is idle, utilizing current from the battery.

ARE your headlights dangerous?
Do you realize that a blinding glare in the eyes of the other fellow may bring a catastrophe to you and yours?

In a remarkably usable article in next month's issue Mr. Platte will tell how to make simple adjustments to assure safety to yourself and others in night driving.



A few drops of petroleum ether, injected into the petcock of each cylinder with a priming gun, is an effective means of starting

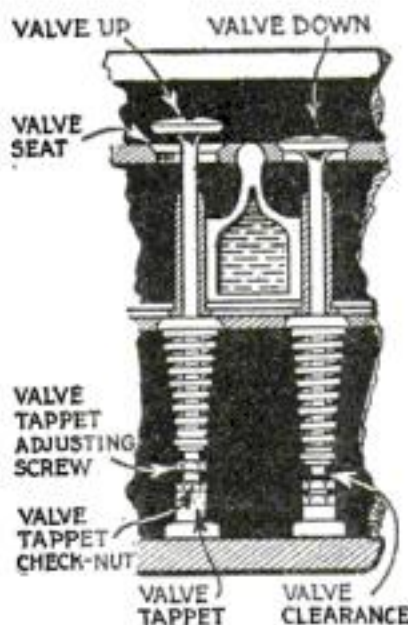


A primer with dash control provides an easy means of quick starting on a cold day

Know Your Car

YOUR Cylinder Valves—There are two valves for every cylinder; one to admit the explosive mixture and the other to release the burned gases. Opening and closing are regulated by the action of cams attached to a shaft that conforms in its turning with that of the main shaft, with which it is connected through gears. As the cam turns, it raises and lowers a small piston called a "tappet." The vertical motion of this tappet is transferred to the stem of the valve, causing the latter to be raised from its seat when it should be open and lowering it when the port should be closed. A spring surrounding the stem serves to keep the valve stem pressed against the tappet during this movement.

In order that the valve may seat properly, the tappet must be separated from the stem when in its lowest position. The amount of this air gap varies in different cars from the thickness of tissue paper to one sixteenth inch.



New Inventions for Auto Comfort



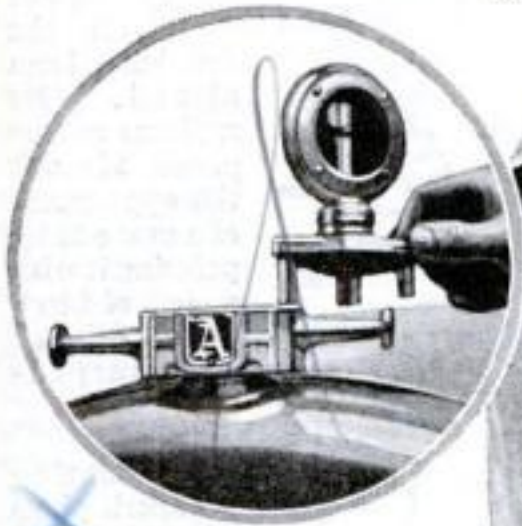
Equipped with a control lever within easy reach of the driver's fingers, this auto light dimmer has the advantage that its mechanical parts are inclosed in a steel housing. Installation requires no hole boring nor rearrangement of the lighting system



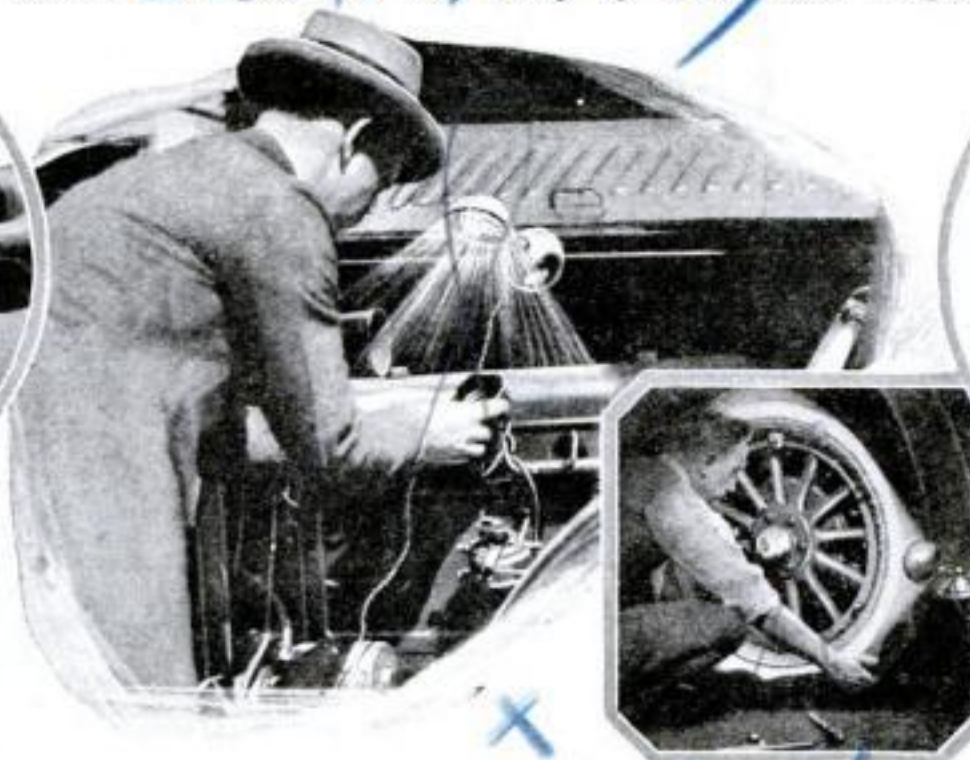
Operating the spotlight from within a closed car is possible with a new lamp inserted in the windshield and controlled by the driver by a pistol grip and trigger switch. The device is inserted in a hole bored in the glass and held firmly by broad metal flanges



Three numbered dial rings below the steering wheel spider control this new combination safety lock. Setting the combination with the rings locks and unlocks the steering post when a small lever is lifted



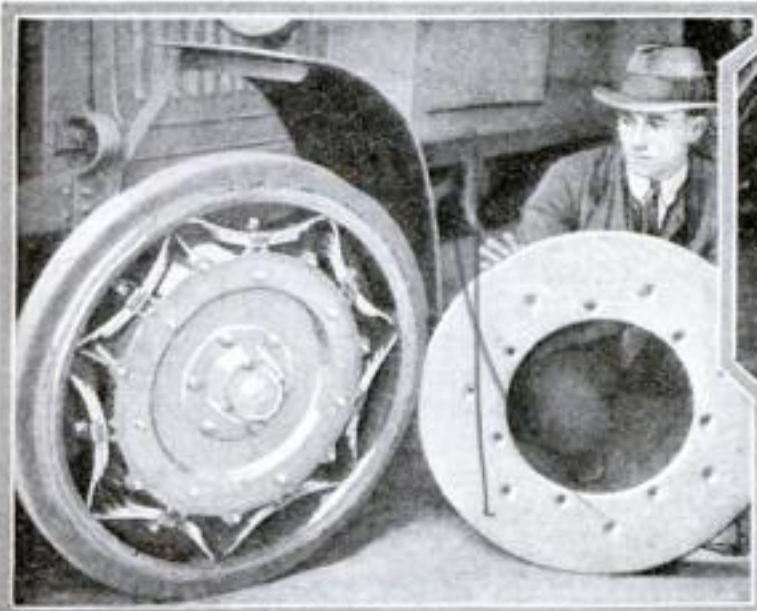
A radiator cap that swings aside when the radiator is to be filled is said to be theftproof and to prevent jarring of the motor. Turning a knob on one of the wings permits the cap to slide up and swing to the side



This folding automobile lamp can be placed in any position on the car where illumination is needed, and is attached by means of a ring and a U-shaped spring clamp at the base



A combination rear view mirror and parking light is an unusually useful auto attachment. Turning the mirror to face downward automatically switches on the light attached to back of mirror. The switch is concealed in the bracket arm



Resiliency of pneumatic tires is claimed for this spring wheel designed for heavy, solid-tired trucks. Short leaf springs radiate from the hub



Crawling under the car is said to be unnecessary in operating the jack shown above and at the right. Turning a thumbscrew attaches the jack to wheel rim and hub



The jack in operation. Its broad base is brought to rest on the ground simply by driving the car slowly forward or backward

Handy Kinks for the Auto Owner

WHENEVER spark plugs are carried loosely under the seat or in the toolchest, it is often found that the porcelains have been cracked. A safer and more convenient method is to carry the spare plugs on a rack fastened to the dash under the hood (Fig. 1). A wooden strip, bored with holes to receive the threaded ends of the spark plugs, is fastened with wood screws under a bent strip of sheet steel, which has slots to

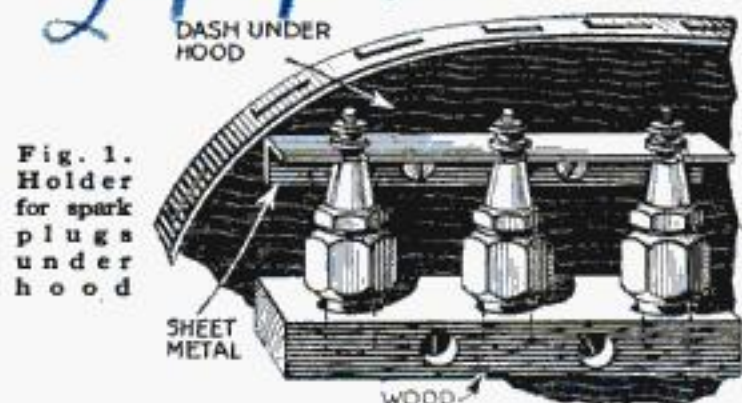


Fig. 1. Holder for spark plugs under hood

receive the contact screws of the plugs.

A COMBINATION parking and trouble light, easily made in the home workshop, is shown in Fig. 2. A flange attached to the side of the body supports the tee extension of the lamp, which is held in place by a wing screw. The 1½-in. opening through the flange allows a 20-ft. length of lampcord to be passed in underneath the seat without lifting the cushion. A switch may be installed integrally with the lamp or a separate switch may be placed on the dash.



Fig. 2. Trouble light



Fig. 3. Clip for cup

A SPRING clip fastened to the grease cup as shown in Fig. 3, will prevent the cap from becoming unscrewed and falling off. The clip is held in place by the stem of the cup.

FAILURE of a tail lamp to light is sometimes caused by a short circuit in the ground circuit when the frame of the car is used as the ground. This is more apt to happen when the lamp is mounted on the tire carrier. Running a wire from the lamp bolt back to the frame of the car will show whether this is the trouble.

THE ignition locks on automobiles seldom are designed to make the car completely thiefproof. Knowing the construction of the various types of ignition

locks, criminal mechanics readily find means to wire around them and start the car without the aid of a key.

However, by inserting a secret breaker in the circuit, as shown in Fig. 4, it is an easy matter to outwit the thieves. One of the wires from the battery is led to a

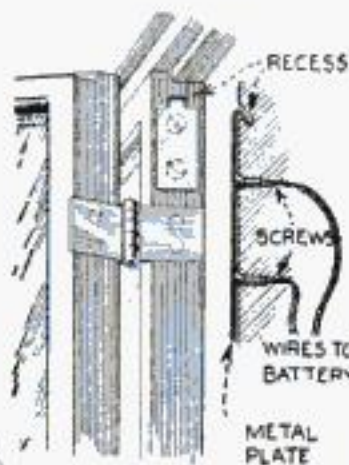


Fig. 4. Theft switch



Fig. 5. When stuck in a mud hole, a machine can be raised to solid ground by fastening a short length of wood or heavy rope to the rear wheels

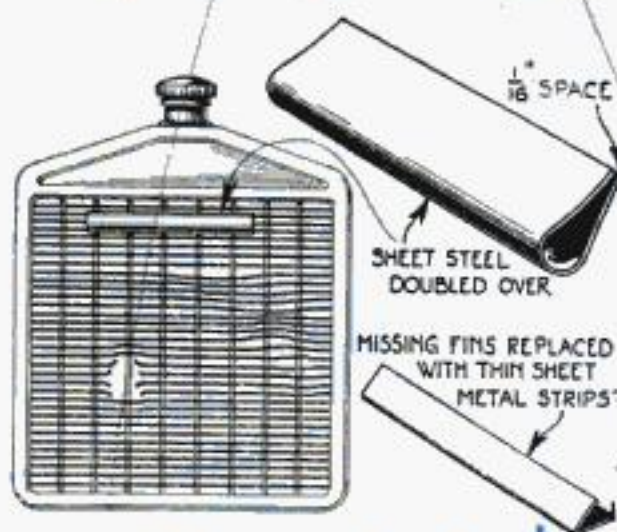


Fig. 6. Straightening and repairing radiator fins

screw in the jamb of one of the doors before passing to the general system. A second screw is situated about an inch from the first one and is connected with the wire leading out. A small notch is made in the wood slightly above the upper screw to hold the hooked end of a small metal plate. Closing the door holds the plate firmly against the heads of the two screws and the circuit is closed. When the

car is parked, it is necessary only to take out this plate to break the circuit.

IF THE fins of a tubular radiator are badly bent, they can easily be made even and straight by using the tool shown in Fig. 6. This is a sheet of steel plate, doubled over at the center so as to leave the edges about 1/16 in. apart. The tool should be about 12 in. long. When fins have been broken out, they can be re-

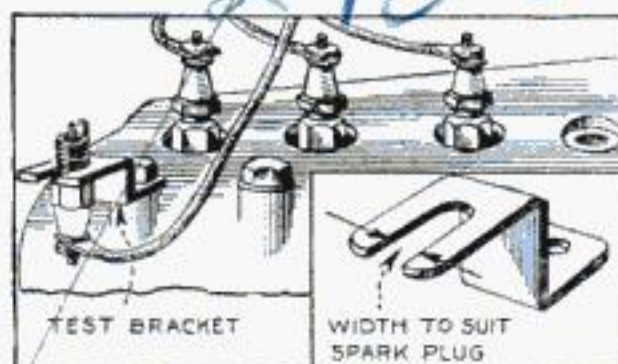


Fig. 7. Bracket useful for testing spark plugs



Fig. 8. Removing pins

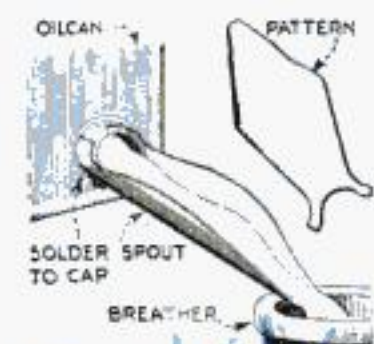


Fig. 9. Oil spout

placed by thin sheets of brass soldered in place and straightened. After all the fins have been aligned, the radiator can be given almost the appearance of a new one by painting it with a coat of black paint diluted with turpentine.

FOR testing spark plugs rapidly and without danger of being shocked the holder shown in Fig. 7 has been found satisfactory. It is simply a piece of steel or brass with a hole drilled in one end and a slot in the other end large enough to fit the plug thread. The bracket is held under a cylinder head bolt in such a position that all leads will readily reach a plug held in it.

TAPERED cotter-pins in pump-shafts, generator couplings, and in the engine of an automobile are frequently located where a hammer or other tool cannot be placed so as to permit of driving them from below. Many times the mechanic will drive them from above and they will fall into the engine pan. Figure 8 shows a quicker method of removing such pins.

THE detachable oil spout shown in Fig. 9 is made of a small piece of tin soldered to an extra oilcan cap from which the top has been cut. The spout is used for pouring oil without waste into the breather tube of an auto.



The Home Workshop

Arthur Wakeling, Editor

Sewing Cabinets Home Craftsmen Can Build

THIS especially dainty and attractive Priscilla sewing cabinet, which costs little for materials and requires no elaborate joinery, is an ideal piece of furniture for construction in the home workshop.

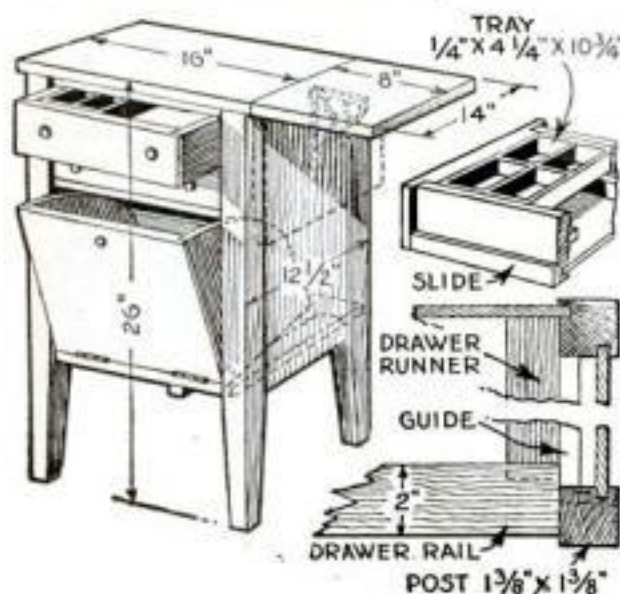
If you have a place in your home for such a cabinet—and in most homes a corner of the living-room, if not a special room is set aside for sewing—it will well repay you to build one. Don't let the turned posts and stretcher deter you, because if you have no access to a lathe, you can have them turned quite reasonably at any carpenter shop where there is a lathe, or at one of the small woodturning shops to be found in all cities and many towns.

Many requests have been received from readers for a magazine article or a blueprint on a Priscilla or, as it is sometimes called, a Betsy Ross sewing cabinet; and the general interest among home workers in this type of project is indicated by the fact that the now famous Home Workshop Blueprint No. 1, a sewing table, issued exactly two years ago, is still in great demand and hundreds of copies are being sold.

It is true that Priscilla cabinets can be purchased for small sums in department and furniture stores, but there is no comparison between the average cheap commercial cabinet and one made by hand from genuine selected walnut or mahogany along lines as structurally and

improve and gain with passing years the richness and beauty of surface that distinguish fine heirlooms and antiques.

As an additional aid for those who wish to build the cabinet, a blueprint (No. 31 in the Home Workshop series) with full size details has been prepared and can be obtained for the nominal charge of 25 cents to cover the cost of blueprinting, handling, and mailing.



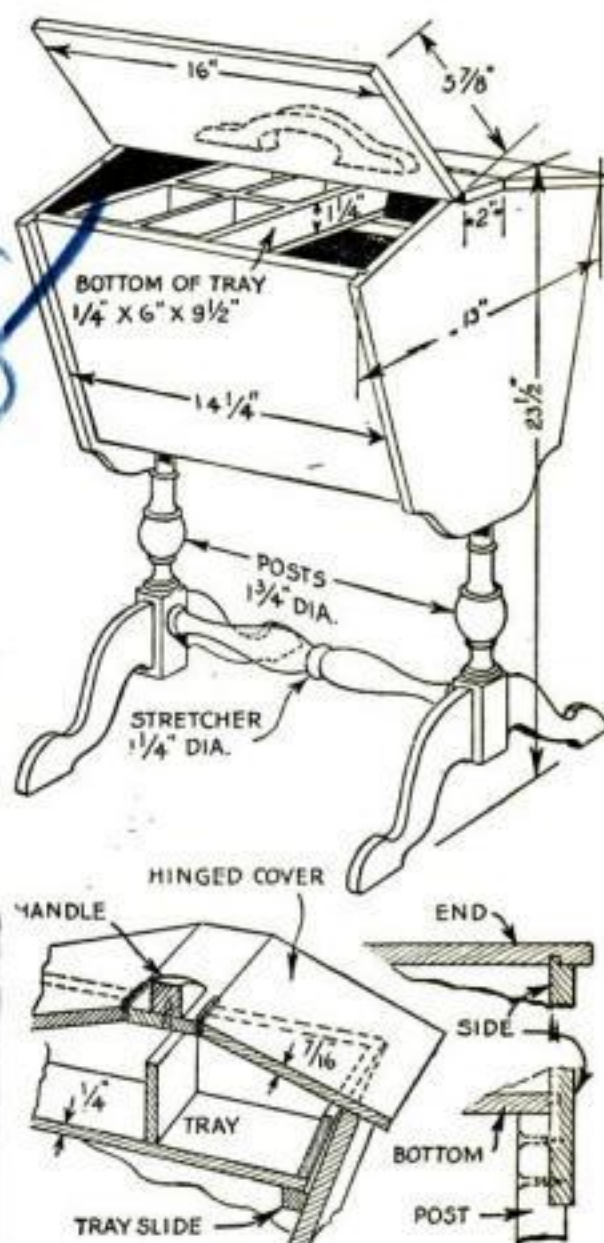
An alternative design for a modern sewing cabinet, which does not require any turnings

artistically sound as this cabinet. Commercial cabinets, unless of the best quality, will deteriorate with age; this cabinet, if built and finished properly, will actually

This useful and beautiful Priscilla cabinet in genuine mahogany or walnut will grace any sewing room

So little material is required that it will pay to use walnut or mahogany. The case itself requires stock about $7/16$ in. thick. A board or two should be obtained sufficient to cut the two sides 10 by $14\frac{3}{4}$ in., the two ends, $11\frac{1}{2}$ by 13 in., the two lids $5\frac{7}{8}$ by 16 in., and a strip for the top center 2 by 16 in. The posts or standards require 2 pieces $1\frac{3}{4}$ by $1\frac{3}{4}$ by $10\frac{1}{2}$ in., either solid or glued up from $7/8$ -in. stock, and the stretcher requires a piece $1\frac{1}{4}$ by $1\frac{1}{4}$ by 14 in. Each pair of feet is cut from one piece of $7/8$ -in. stock 4 by 8 in., and the handle requires a piece $7/8$ by $1\frac{3}{4}$ by $10\frac{1}{2}$ in.

The rest of the stock need be only $\frac{1}{4}$ in. thick. The bottom of the case is 6 by



Construction of Priscilla sewing box with main dimensions and details of the important joints

14 $\frac{3}{4}$ in.; the bottom of the tray, 6 by 9 $\frac{1}{2}$ in. The sides of the tray are 1 $\frac{1}{4}$ by 10 $\frac{3}{8}$ in.; the ends of the tray, 1 $\frac{1}{4}$ by 5 $\frac{1}{2}$ in. The long division in the tray is 1 $\frac{1}{4}$ by 9 $\frac{1}{8}$ in.; the center division 1 $\frac{1}{4}$ by 5 $\frac{1}{2}$ in., and the tray rests or slides are $\frac{1}{2}$ by 14 $\frac{1}{4}$ in. To reinforce the bottom, 2 pieces $\frac{3}{8}$ by $\frac{3}{8}$ by 14 $\frac{1}{4}$ in. are fastened underneath the long edges.

Besides these parts of wood, four brass 1 by 1 in. hinges, as well as nails, screws, dowels, and glue are required.

Note the tongue-and-groove construction of the case joints, between both the sides and the ends and between the ends and the bottom. The stretcher is tenoned into the posts, and the feet are attached to them with dowels.

If for any reason turnings cannot be obtained easily, the modern sewing cabinet illustrated in the left-hand column is an excellent alternative design. The essential dimensions and details are

(Continued on page 122)

Unique Ski Sleds Provide Healthful Sport

WHEN you're pilot of this chummy tandem scooter (Fig. 1) and the other rider swings up behind after pushing off, you can be sure of a speedy joy ride, right side up.

If good staves are not available, ski material must be steamed (see Howard Greene's article on skis in last December's POPULAR SCIENCE MONTHLY) and, when partly cooled, wired to posts, as shown. The front post is shaped from a 38-in. length of 2 by 3 in. stock, 31 in. of which is rounded off to 2-in. diameter. Cut the rear post 9 in. long, and square one end for a distance of 2 in.

To each post, center and fasten a shoe with finishing nails sunk into the bottom. A mending plate is riveted beneath the toe and heel of each shoe, the end holes being left free for the wire.

For stringing a shoe, 7 ft. of wire is needed. It is passed through screweyes set 1 in. below the shoulder of the posts, as indicated.

The runningboard is 5 by 38 in. Center one post hole 3 in. from the front end and make a slot 4 in. long in the other end for suspending the rear post. Before inserting the long screw pivots, round off the shoulders of the rear post so that it can swing backward and forward.

The seat framework is built of 2-in. wide strips. Cut the middle upright 22 in. long and center to the runningboard with a corner iron 17 in. from the front. Cut the rear strip 25 in. long and hinge one end to the top of the post as shown. Two more strips 24 in. long form the foundation for the front seat. One can be 2 in. longer, if desired, to make a rung for supporting a horn. The seat board is 7 in. wide and 20 in. long, the seat proper being approximately 7 in. square and the remainder being trimmed to 4 in. wide. Center a hole for the front post 2 in. from the front end.

The rear seat board is 23 in. long, with a square seat. The forward part is 5 in. wide. It is fastened to the upright 16 in. above the runningboard with a long screw

By Roland B. Cutler

The handle-bar is 14 in. long, clipped at the top of the post with a 4-in. strap hinge. Under the end of the front seat construction, 4 1/8-in. hardwood plugs or dowels key the post to the frame. Bore the holes for them at quarter points around the post and allow the plugs to extend

Nail the ledge pieces over the shoulders, centering each post 15 in. from an end. Set this frame on the shoes and locate the end holes in the hinges for wiring. These wire holes are centered in the shoe about 2 in. apart. Midway between the posts, make two pair of holes 6 in. apart, and in the ledge, center one wire-hole above each pair.

Loop 13 ft. of wire, with equal ends, through a screweye at one end and then wire as shown, keeping the ledge and shoe parallel. Tap all bends in the wire to fit snugly, and cut into the edge of the ledge for the wire to pass. Secure this wiring in the opposite screweye.

A 5-in. strap hinge connects the end of each ledge and shoe. A stove bolt is passed through the end hole of each strap, and a 3-in. mending plate is used in place of a washer on the inside. Trim the shoes to about 1/4 in. thickness and bolt the hinges only to them.

To bend and to hinge the ledge, use a thick piece of board, as shown at the right. Notice the large hole in which the end of the hinge flap must rest, flush with the under side. Bolt the end of the ledge to one of the hinge screw holes. With this "squeezer" drawn over the ledge, the end hole of the flap can be located, and the fastening made as to the shoe. The middle seat

boards are 50 in. long, and the side boards are 40 in. long.

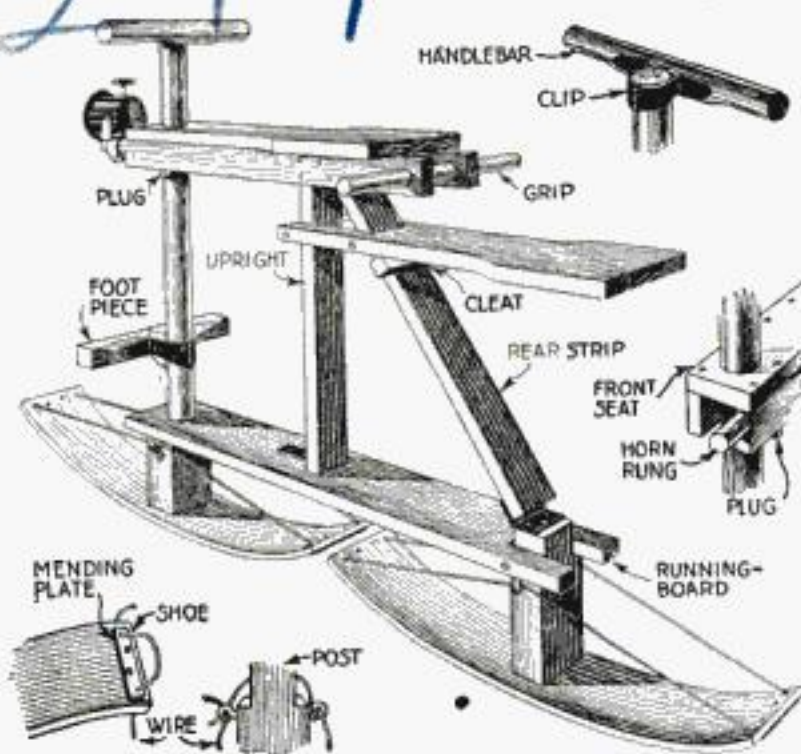


Fig. 1. The tandem scooter completely assembled and some of the details. Note how the rear shoe is pivoted to runningboard

1 in. to support the three seat members. The list of materials for the scooter is as follows:

- | | |
|---|-------------------------------------|
| 2 wide barrel staves, or ski material of similar size | 1 board 3/4 by 7 in. by 10 ft. |
| 6 ft. of 2 by 3 in. studding | 4 screweyes, 1 1/2 in. |
| 1 light strap hinge, 4 in. | 1 doz. screws, No. 12, 2 1/4 in. |
| 1 light strap hinge, 6 in. | 2 doz. screws, No. 7, 1 in. |
| 1 corner iron, 4 in. | 8 rivets, No. 9 |
| 1 hinge butt, 2 in. | 14 ft. soft galvanized wire, No. 12 |
| 4 mending plates, 4 in. | |

The light, springy coaster (Fig. 2) is geared up to ski speed and will shift into "high" at one push of a toe accelerator. Although only 5 ft. long, it will not limp under any overload, for it's built for business as well as speed.

The hardwood stock required is as follows:

- | |
|---|
| 2 shoes, each 3/4 by 3 by 66 in. |
| 2 ledge pieces 3/4 by 3 by 66 in. |
| One 16-ft. length of flooring, 3/4 by 3 in. |
| 2 beams, each 1 by 4 by 15 in. |
| 4 posts, each 1 by 2 1/2 by 7 in. |

The hardware necessary is:

- | |
|-----------------------------------|
| 4 light strap hinges, 5 in. |
| 8 light T-hinges, 3 in. |
| 16 stove bolts, 3/16 in. by 1 in. |
| 5 doz. screws, No. 6, 1 in. |
| 26 ft. galvanized wire, No. 12 |
| 4 corner braces, 4 in. |
| 8 mending plates, 3 in. |
| 1/2 doz. screweyes, 1 1/2 in. |
| 1 doz. screws, No. 8, 1 1/2 in. |

Shoulder each end of the beam 1 1/2 by 3 in. long and fit the shoulders into 1 1/2-in. deep mortises in the posts. Fasten posts and beams together with screws at each side, as shown in the left-hand detail. Under each beam place two 4-in. corner braces. To the lower end of each post attach the flap of two 3-in. T-hinges. Note the screweye inserted through one hinge for wiring.

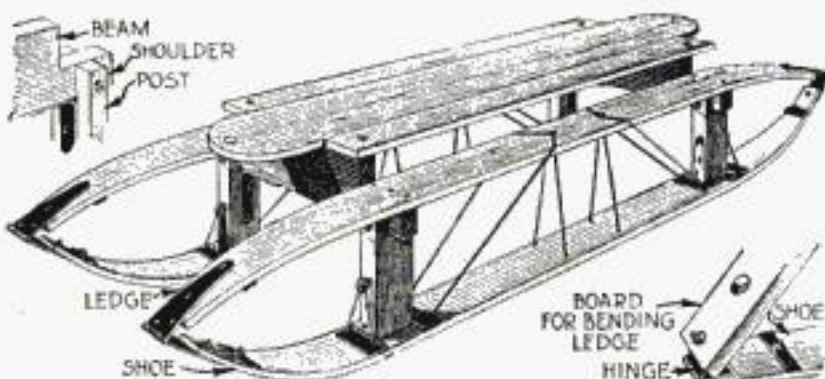


Fig. 2. The ski coaster, which is built easily and cheaply because the double-end runners can be sprung into shape without steaming

at each side. The hand grip is a 12-in. length of broomstick secured in holes centered 1 1/2 in. from the ends of the strips supporting the front seat.

For steering aids, split a 2 by 3 in. piece into two 12-in. lengths, 1 1/2 in. wide. For the foot-piece bend 1 1/2 in. of the ends of a 6-in. strap-hinge clip as shown, and insert a wedge between the parts, securing it with a nail through each middle screw hole.

Special Line Holder Aids in Fishing through the Ice



If an old chair cannot be found, this holder can be made easily from other material.

THOSE who have tried the ordinary and not entirely satisfactory ways of holding the line in ice fishing, will find useful the line holder illustrated.

To make one like it, hunt up a discarded chair and cut off a length of one of the turned legs, as shown, leaving parts of two spindles connected with it.

A sharp point for the holder is provided by inserting a nail, about 2 1/2 in. of which is allowed to protrude. File the head end to a sharp point and provide a ferrule, if possible.

When ice fishing, let down your line to the right depth and jab the spike into the ice. When your bobber begins to dip, signaling a bite below, the holder can be instantly seized.—ROBERT PAGE LINCOLN.

Saving Money in Building a Small House

By R. J. Stephens

IN building a home, few of us plan far enough ahead. We find later that we should have had a breakfast room, more attic space, or something equally expensive or perhaps impossible to add.

If you are short of funds when you build or buy your home—and who is not?—plan so that you can add to the house without detracting from its graceful lines and without giving the additions the appearance of an afterthought. If you are thinking of building this spring, start at once to make as complete plans as possible.

It would be folly to suggest one ideal type of a small house; yet, countless as are the excellent plans furnished by various agencies in the building industry, many prospective home builders are unable to decide on just what they want, or, having decided, eventually find a lot of changes they would like to have made.

As regards the small house, it goes without saying that the two-story type is the most economical. It doubles the floor space on the same foundation and under the same roof.

It is better to have fewer rooms and at least one large living-room in which to "live" and receive your guests than to cut up a house into little rooms or cells, as indicated by the two typical plans below. A large living-room can be a combination living-room, dining-room, and even bedroom.

Every time you add a partition, you have added four corners to your floor space, which are good for nothing except to set a piece of furniture in; at the same time you have cut off air and light, added further expense, and in some instances made the house more difficult to heat uniformly.

Cheap as is a concrete foundation, it can be made cheaper by a little common sense in building it. Concrete work is hard and yet I have seen many men mixing their material far away from their forms, hauling the extra weight of water, slopping it all over, losing lots of it, and

where wheelbarrow trestlework would otherwise have to be built around the forms. On a level lot the idea works even to better advantage. The idea is not to haul the mixture after mixing, but to arrange so that the concrete can roll right off the mixing board into the forms practically by gravity.

For foundation work, I have found it sufficient to turn the dry mixture only once and then to apply plenty of water.

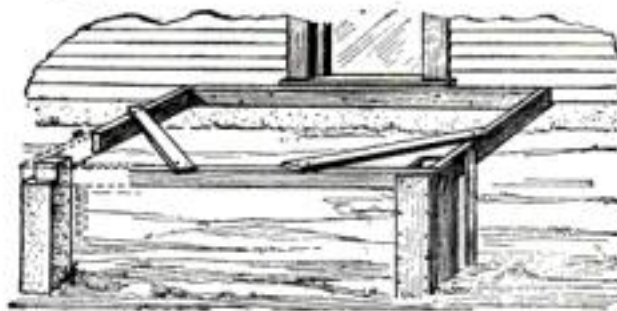
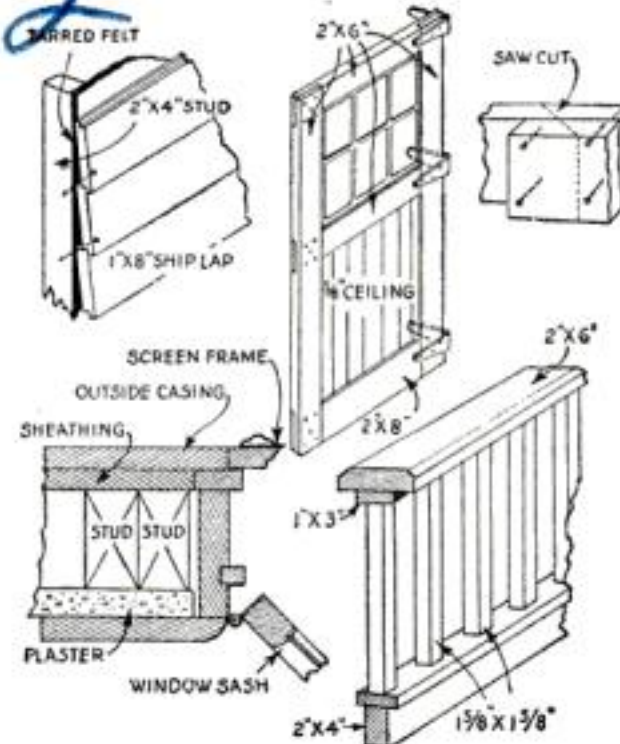


Fig. 2. Above: Five building suggestions that are simpler than the standard construction. Fig. 3. At left: An unusually easy way of making porch piers and frame

In Fig. 3 is shown an easy method of constructing porch foundations and framework without wasting any time making unnecessary calculations. Cut the four outside joists according to the length and width of the porch and nail them all square and level with the aid of two temporary 2 by 4 in. supports. Nail braces across the corners to hold the frame square and then construct the forms for the piers from 8, 10, or 12 in. boards at the outside corners. A few nails set at random inside the joists at the corners will help strengthen the work when the concrete is poured. You will see, also, that the joists rest on square shoulders of the piers, which is excellent construction. A small house that is to be set on a foundation of piers can be laid out in the same way.

Wide drop siding, which is quite popular in many parts of the country, can be imitated at a considerable saving, as shown in Fig. 2, by using ordinary ship-lap, one of the cheapest varieties of lumber. Being much heavier than regular drop siding or clapboards, it can be applied over good tarred felt directly to the studs and does away with the necessity for using sheathing, when the building code allows. This is a substantial saving in both time and material and yet makes a house warm enough for any moderate

climate. In such construction it is, of course, necessary to set the door and window frames before applying the siding. The casings should be shimmed out with lath so that the ends of the siding will not project beyond them.

The simple construction of garage doors shown in Fig. 2 involves making only simple saw cuts. If the joints are close and put together with screws, such a door will need no braces to prevent its sagging. The sash used in this door is the regular 32 by 32 in. sash salvaged from

government cantonments and usually obtainable at second-hand lumber companies for about \$1.25 each.

Note also the use of common barn door hinges, which can be purchased for about 10 or 15 cents each. If hinges are selected that will open back to 90 degrees, one leaf can be placed on the inside of the door jamb, thereby making the hinge look like a regular garage door hinge. This type of door is illustrated in Fig. 1.

In an article published in the January, 1923, POPULAR SCIENCE MONTHLY about my home, I showed a proposed extension of a porch and this photograph indicates how the extension was finally completed with a garage below. By opening a basement window, the garage can be heated sufficiently in winter. The porch above the garage is finished in pergola effect, which makes it cooler in summer and does not shut out the sunshine in the winter from the triple window that opens on it. The ease with which this addition was made was due purely to foresight in planning.

An easy method for building porch and stair railings is shown in Fig. 2. Prac-

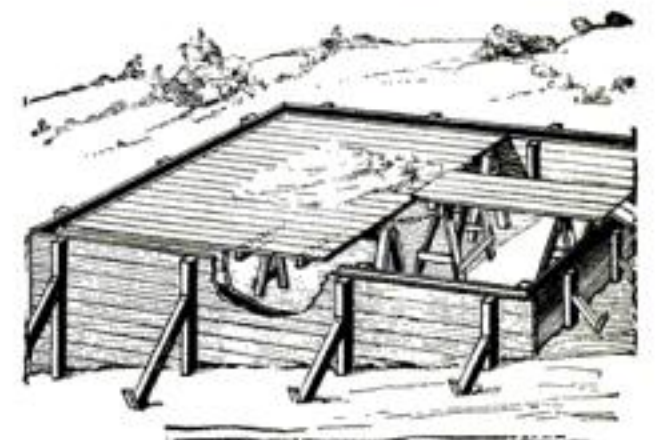


Fig. 5. Labor and often scaffolding can be saved by this method of mixing concrete



Fig. 4. Typical bungalow plans, the one at the left having all the advantages

handling it twice instead of once. Build the mixing board, if possible, so that it is lipped over the edge of the forms (Fig. 5). This practically cuts the labor of mixing and pouring in half.

The illustration shows the method used where there is a high exposed wall and

tically no nails are exposed and there are no places to catch and hold the moisture. The 1 by 3 in. strips are first nailed to the spindles, and afterward the strips are nailed to the 2 by 4 in. bottom rail and the 2 by 6 in. top rail. Since such

(Continued on page 139)

Making Your Loudspeaker Talk Up

An Easily Constructed Two-Stage Amplifier that Can Be Added to Any Ordinary Radio Detector

NO SINGLE piece of radio apparatus, with the exception of a detector unit, is of greater value to both listener-in and experimenter than a two-stage audio-frequency amplifier unit.

By adding such a unit to a standard detector circuit, the strength of the incoming signals can be built up to a point where a loudspeaker can be operated with sufficient volume to fill a large room and, under favorable conditions, an entire house. It is then no longer necessary to distribute a pair of phones to each person until the assemblage takes on the aspect of a convention of telephone operators.

Distant stations usually come in best on earphones when a single stage of audio-frequency amplification is used with a detector unit. When a good aerial is used, two stages of audio-frequency amplification added to a detector circuit will bring in on a loudspeaker, loudly and clearly, stations 500 and more miles away.

The two-stage unit enables the experimenter to add amplification to any of the various types of detector circuits he wishes to try out without the necessity of incorporating two stages in each set.

If care is exercised in the construction, no difficulty will be experienced in its operation. Most of the trouble in amplifier circuits is usually due to the use of faulty parts, not properly tested before being placed in the circuit; to the incorrect location of parts and wiring, or to slipshod methods of construction.

Standard Circuit Is Used

Before attempting to build the unit, read over carefully Jack Binns' article on troubles and their prevention, appearing elsewhere in this issue.

The circuit used in this unit is the standard, tried and tested audio-frequency amplifier circuit shown in the wiring diagram.

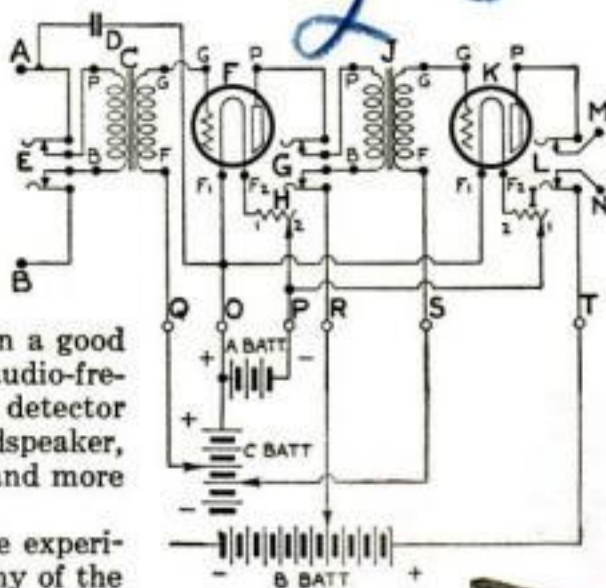
A 7 by 10 in. panel was used for this unit, but if you can spare the space, a 7 by 12 in. panel will make it easier to construct and perhaps give slightly better results.

A standard transformer coupling is used, the first stage being coupled to the detector circuit with a high-ratio audio-frequency transformer, while the second stage is coupled to the first stage with a standard amplifying transformer of low ratio. The ratio of the first transformer, *C*, may run as high as 10 to one, but that of the second transformer, *J*, should not be higher than about five to one. Two low-ratio transformers can be used, but two high ones are not advised. The transformers should be mounted so that they are at right angles to each other. Placing them at opposite corners will separate them as much as possible and reduce interaction between circuits.

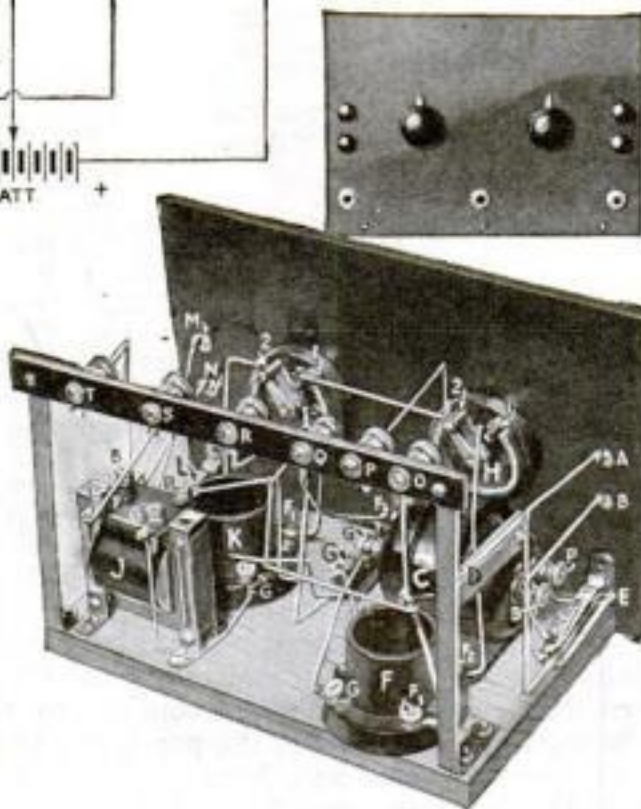
Separate rheostats are used for each

By Joseph Calcaterra
of POPULAR SCIENCE MONTHLY'S
Radio Staff

tube, this arrangement being more desirable than that in which one rheostat controls both tubes. The type of rheostats and tube sockets used will depend on the type of tubes used in the unit. *D* is a .001-mfd. fixed condenser. Three double-circuit jacks are used, the first, *E*, is for



Wiring diagram of the two-stage unit (above) and views of the front and rear of the panel (at right). The letters on the large photograph correspond with those on the wiring diagram.



Without tubes and batteries, this amplifier costs about \$15

inside spring of the detector jack that makes contact with the outside spring connected with the B battery.

The fixed condenser, *D*, is left as connected between post *A* and the positive of the A battery.

Since the negative of the B battery is automatically connected with the filament circuit through its connection with the filament circuit in the detector unit, no connection for the negative of the B battery is provided in the amplifier unit. This is to eliminate any possibility of shorting the A battery. If, for instance, the negative of the B battery were connected with the negative of the A battery in the detector unit, connecting the negative of the B battery with the positive of the A battery in the amplifier circuit would short circuit the A battery.

The same type of tubes used in the detector circuit should be used in the amplifier circuit; use 1½-volt, 3-volt, or 6-volt tubes throughout, or special circuit arrangements will be found necessary.

This unit can be used with the detector unit described last month, if the same type of sockets, rheostats, and tubes are substituted. It would be advisable, however, for greater convenience in connecting the two, to change the battery connections of the detector unit to the back of the set and place the phone posts so that they are opposite the input terminals of the amplifier unit.

Posts *M* and *N* are used to enable you to connect a loudspeaker or additional amplifier with the unit.

A general idea of the method used in routing the connecting wires for greatest

efficiency can be gained by studying the photograph of the unit. Since the parts and terminals in the diagram correspond with the same markings in the photograph, the beginner can follow the wiring of the unit without trouble and gain experience in reading wiring diagrams.

How to Use the Unit

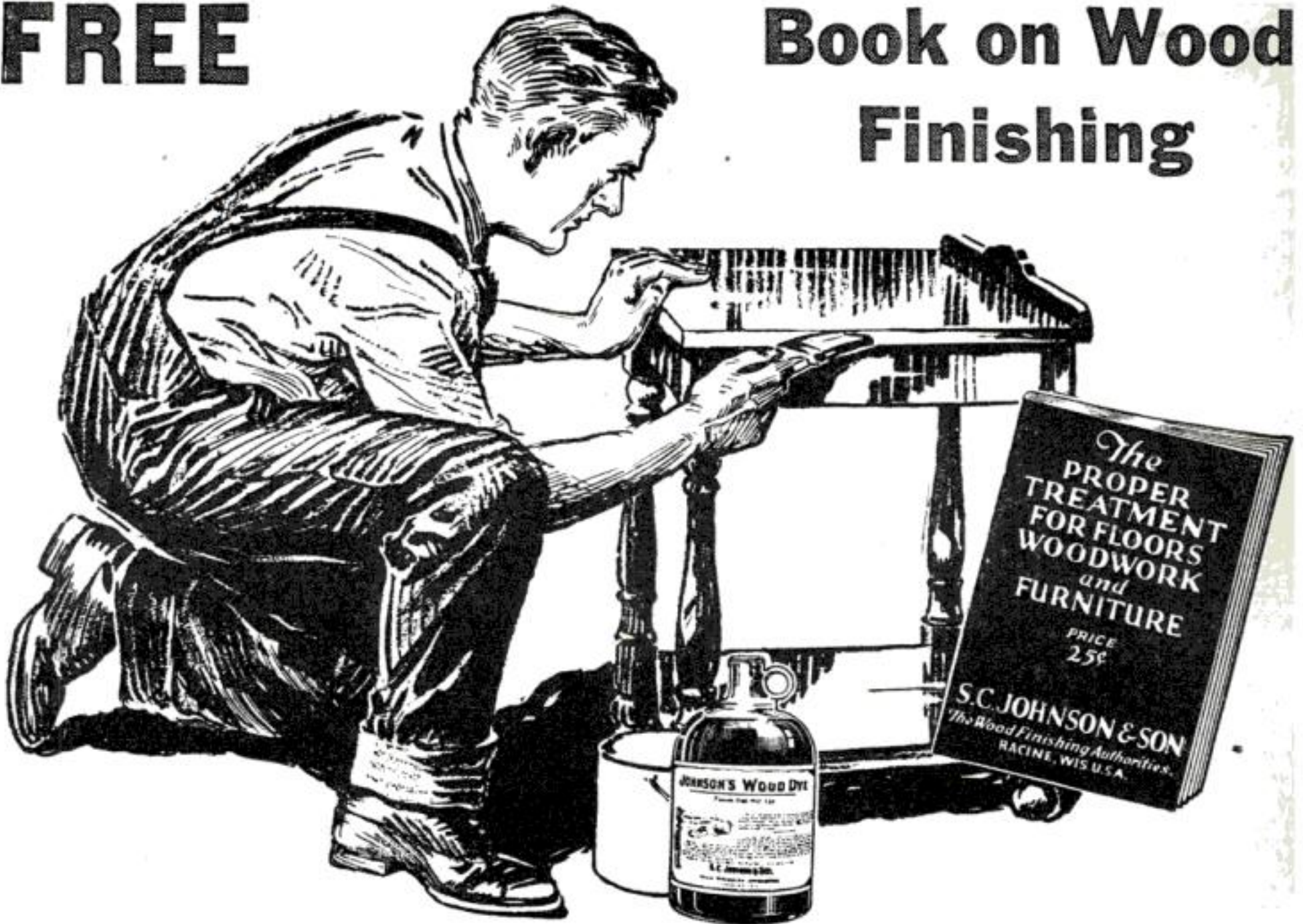
No trouble will be experienced in wiring the unit if the connections are made according to the following directions:

First connect the top spring of jack *E* with post *A*. Then connect the inside spring, which makes contact with the top spring, with the *P* terminal of transformer *C*. The bottom outside spring of jack *E* is connected with post *B*, while the inside spring, which makes contact with the bottom spring, is connected with the *B* terminal of the transformer.

A wire is next used to connect terminal *F*₁ of socket *F* with post *O* and another
(Continued on page 110)

FREE

Book on Wood Finishing



Our book gives complete instructions for finishing all wood—hard or soft—old or new. Tells how inexpensive soft woods may be finished so they are as beautiful and artistic as hard wood. Explains just what materials to use and how to apply them. This book is the work of experts—beautifully illustrated in color—gives covering capacities—includes color charts, etc. Fill out and mail coupon below for a FREE copy.

JOHNSON'S WOOD DYE

Johnson's Wood Dye has many uses, for both the artisan and amateur. *Architects* and *contractors* specify it for coloring woodwork and flooring in new buildings. *Painters* and *decorators*, use it with equal satisfaction on new and old woodwork of all kinds. *Housewives* delight in it for doing over old furniture and for coloring reed and wicker baskets, etc. *Manual training teachers and pupils* use it for finishing their models. *Upholsterers, furniture repairers* and *cabinet makers* find it "just the thing" for their work—old and new.

S. C. JOHNSON & SON, Racine, Wis., U. S. A.

(CANADIAN FACTORY—BRANTFORD)
"The Wood Finishing Authorities"

Johnson's Wood Dye is very easy to apply—it dries in four hours and will not rub off or smudge—penetrates deeply—bringing out the beauty of the grain. Made in fourteen popular shades all of which may be easily lightened, darkened or intermixed. Full directions on every label.

S. C. JOHNSON & SON, Dept. P. S. 2, Racine, Wis.

"The Wood Finishing Authorities"

Please send me free and post paid, your Instruction Book on Wood Finishing and Home Beautifying.

MY DEALER IS

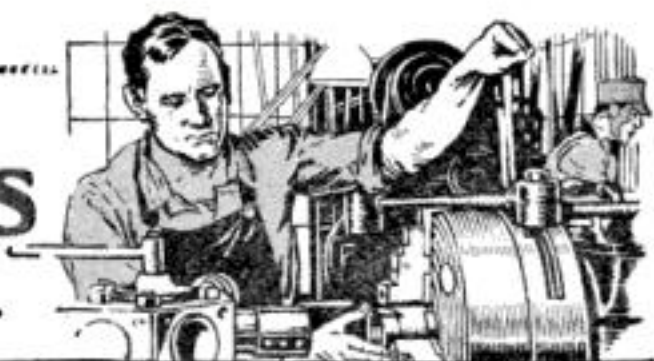
MY NAME.....

ADDRESS.....

City & State.....

Better Shop Methods

How Expert Mechanics Save Time and Labor



Secrets of Success in Handling Taps and Dies

"WHAT'S the matter over here, Bill?" called Tom at the No. 9 tapping machine. "I've just broken another tap—the third this morning—and I don't know what is causing it."

Old Bill shut down his machine and crossed over to where Tom was gazing perplexedly at a handful of broken taps. Just a glance gave Bill the solution. The work holder had slipped a trifle out of alinement, not enough to be obvious, but, nevertheless, sufficiently to make the tap run to one side and break. When the work holder was again located centrally with the tap, all trouble on No. 9 ceased.

Just as Tom, a pretty thoroughly experienced mechanic, was confronted with a tapping problem he could not solve, so many of us go about our work wondering why taps break, dies are ruined, and threads are torn. A few of Bill's suggestions to his fellow workers eliminated much of the tapping trouble in the shop where he worked.

"Not half of the so-called mechanics know how to lubricate a tapping job," was Bill's criticism at one time.

Most men use common machine oil for all hand tapping. On steel and boiler plate one should use a mixture of lard oil and white lead of the consistency of thin cream. It is well to have a can of this lubricant on hand at all times.

Cast iron and brass are best tapped dry. Whenever a lubricant is absolutely necessary with these metals, kerosene is the best to use. Lard oil, sperm oil,

By Joe V. Romig
Tool Designer and Builder



Multiple tapping, which requires the expert application of the principles Mr. Romig outlines in this noteworthy article

that the labor of hand tapping can be reduced considerably by the use of a good lubricant.

Screw-machine dies sometimes clog and twist off the stock, the latter being almost impossible to remove from the die. There are a number of causes for this, one being improper lubrication. When the lubricant stops flowing, heat is generated, the metal expands and the die cuts fast. Unless a proper lubricant is used, the same thing happens. A third cause is the use of dull dies. Hard stock is also likely to damage a set of dies, for it is not always possible to detect the hardness as it passes through the forming and turning tools.

A common occurrence is to have taps continue to break without having anything wrong with the machine or the set up. At one time several different makes of taps were tried out on a hard job of tapping 3/16-24 threads in tough steel, but many of them broke. The foreman checked up the speed, the set up of the work, the alinement, and found that a good lubricant was being used, and he was at a loss to know the reason for the breakage. Old Bill ran a file across one of the taps and solved the problem for him. The hardness ran uniformly from front to rear, and while the front end was just right to cut hard steel, the rear and middle were too brittle to withstand the strains and therefore broke.

By holding the taps with their square ends in a Bunsen burner flame, he drew

the temper to a dark brown and graduated it toward the front to a light straw color. This in no way affected the hardness of the cutting threads, but it toughened the body so it could withstand the great twisting strains.

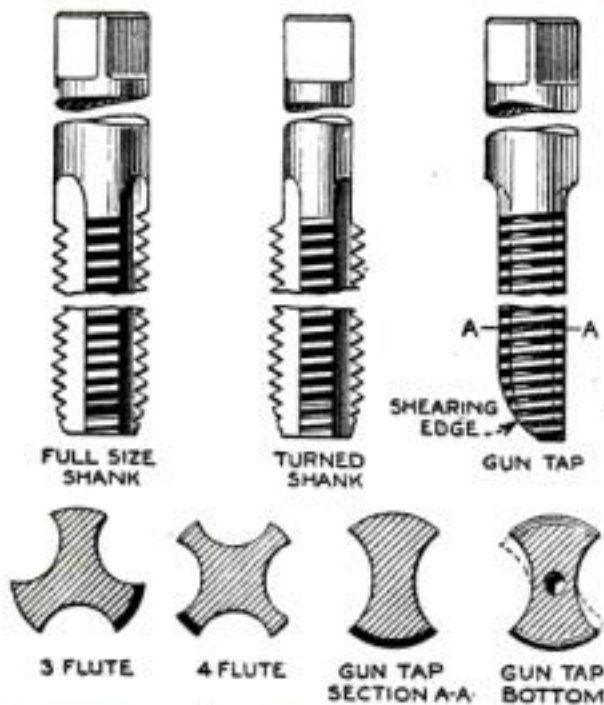
Where extreme accuracy is required on a threading job, a roughing tap or die should be followed with a finishing tool, which sizes the job by removing only a few thousandths of an inch of metal. Many manufacturers and builders claim that this should be done only by hand. This is, generally speaking, a reasonable claim, for hand operation allows the tool to float perfectly while the machine-operated tool forces the cut.

Where taps and dies are used on production threading, the man in charge should constantly study every circumstance that has a bearing on the tools themselves, their operation and manipulation. Hardness of stock, the speed of machine spindles, proper lubrication, and perfect alinement of the spindle with tap or die head are important items to be considered.

Alinement, both vertical and horizontal, is absolutely necessary to cut accurate threads. Many cases of tapered, one-sided, uneven, stripped, and thin threads are traceable to misalignment of the tap or die holder. To compensate for slight errors of machining, the floating tap and die holders were designed, and by their use many otherwise difficult jobs can be made within reasonable degrees of accuracy.

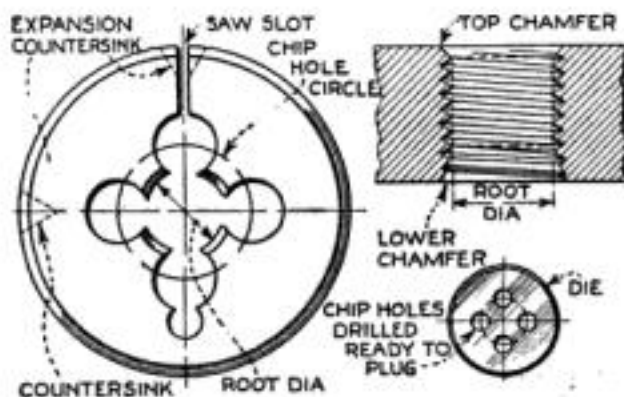
A perfect floating holder should float so that its axis is always parallel to the true axis of both work and holder. A holder which is held in a pivot at its rear will not act properly and is almost certain to cause poor work.

The amount of metal removed by a tap or die plays an important part in the threading operation. To cut a full thread, the maximum outside and minimum hole



Types of taps that can be made in an emergency without very much difficulty

tallow and graphite are excellent lubricants for steel. Soap compound or soapy water is also good. Any kind of lubricant used in tapping cast iron causes the chips to stick and often produces a rough thread. It must always be remembered



Layout for a die, the first holes drilled and large detail of the top and bottom chamfers

diameters must be maintained. A reduction of the amount of metal removed makes the threading operation much lighter at a very small sacrifice of the strength of the thread. In fact, a die and

(Continued on page 98)



"What's the print allow you, Bill?"

"Two thousandths under — nothing over."

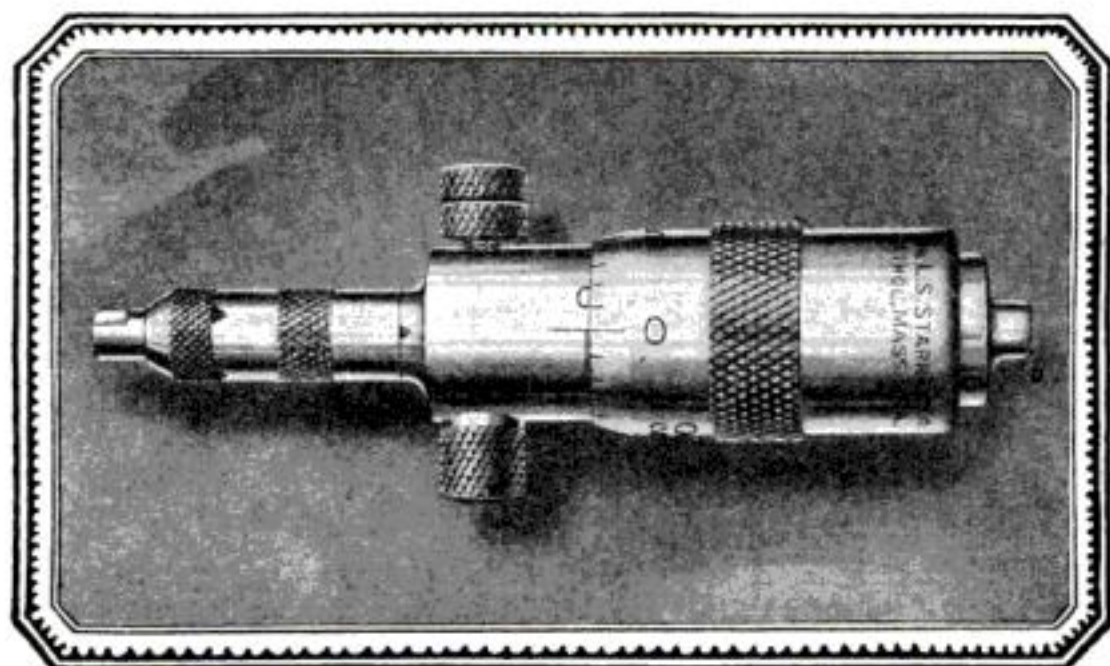
"*With* no chance to fit and try *and* a fine chance of getting fired if you spoil it. All I got to say is it's a good thing you own a set of Starrett 'Mikes'."

THE L. S. STARRETT CO.

The World's Greatest Toolmakers—Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

If your work calls for a Tap Wrench, be sure you pick up a Starrett No. 93 or the larger 93C. Both offer several advantages in general tap and die work. The body is centered enabling the workman to use it on lathe centers or upright drilling machines to start the tap straight. The jaws and knurled clamping nut are heat-treated.

Write today for the free Starrett Catalog listing and describing more than 2200 fine tools. Ask for No. 22-"W."



Inside Micrometer Head No. 124

Use Starrett Tools



6021

Shortcuts for Men Who Work with Tools

PPIPE-FITTERS and repair men usually carry their tools about in portable toolboxes of open design. While an old box rigged up with a leather strap for a handle will answer the purpose, the one shown in Fig. 1 is neater and will prove handier. The slanting sides eliminate the dark corners where small tools have a tendency to hide themselves. The legs raise the box out of the litter too often found on the floors and elevate the tools to a height where they can be conveniently reached.

A HANDY adjustable support that will find many uses around the shop is shown in Fig. 2. It is made entirely of old materials, the screw coming from a discarded piano stool. The pipe is cut to the desired length and fitted with a flange at one end. The pipe is then drilled at the other end with several holes to anchor the babbitt. The screw is babbitted in place. By raising a burr on the thread with a chisel, the screw will cut into the babbitt enough to make it turn freely. The pipe should be warmed at one end before babbitting, to prevent its blowing out before cooling. A V-block is fitted to one end of the piano-stool screw as shown.



Fig. 2. Bar support



Fig. 3. Holding rod rigidly

IT IS almost impossible to cut a heavy thread with a hand die by holding the work in an ordinary vise, as the rod will turn in the jaws. By fastening an ordinary lathe dog to the work, as shown in Fig. 3, and allowing it to bear against the side of the vise, no difficulty will be encountered in holding the work rigidly.

A SATISFACTORY lathe dog for light work can be made from a discarded pulley by elongating the bore as shown in Fig. 4 and securing a drive pin to one of the spokes. The dog is equal to, if not better than, the common type, as the pulley rim prevents the lathe operator's clothes from catching in the driving lug. Moreover the dog is better balanced than the type ordinarily used.

THE drilling attachment shown in Fig. 5, was devised for drilling between the flanges of an I-beam where the usual ratchet wrench was too long to permit of its use. There are many places where such a drill will work to advantage.

A square bar of steel is drilled to accommodate the drill and fitted with a setscrew to clamp it fast. The opposite end is tapped to receive a pointed setscrew with which pressure is exerted on the drill. An open-end wrench is used to turn the drill. The same fixture can be used to tap the holes after drilling.

FOR the purpose of assembling quickly a large number of cap screws, the special screwdriver bit shown in Fig. 6

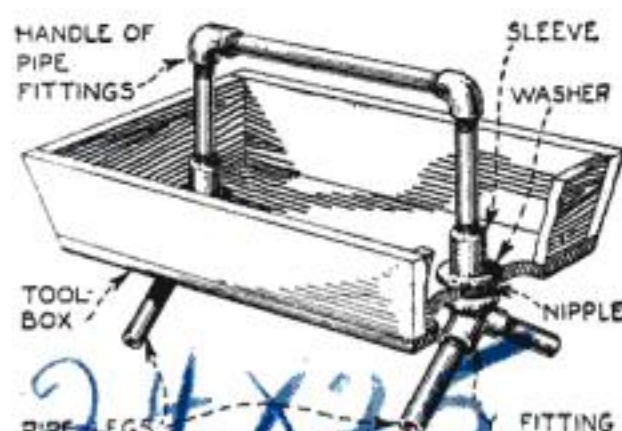


Fig. 1. Repairman's handy toolbox



Fig. 4. Safety lathe dog

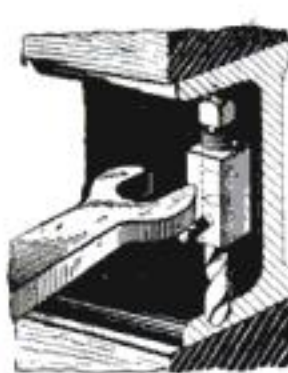


Fig. 5. For drilling

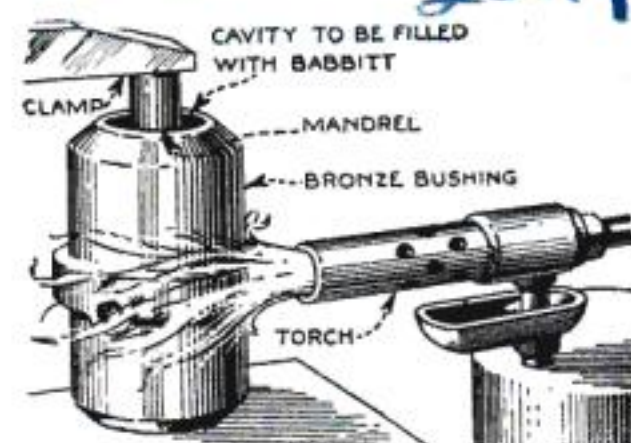


Fig. 8. Babbitting a worn-out bronze bushing

was designed. A split collar engages the head of the cap screw and prevents the blade from sliding sideways. The ends of the collar clamp the screw and permit of inserting it in the screwdriver bit previous to threading it in the hole. The screwed connection allows the collar to be removed when it is necessary to grind the edges of the blade. A locknut prevents the collar from working loose.

OFFSET socket wrenches can be made to operate more easily by adding a bent handle as shown in Fig. 7. A tubular section of brass or iron, from 18 to 20 in. long, is bent into the proper shape to form a crank and one end is riveted to the wrench. A door knob or other knob is attached to the other end.

WORN-OUT bronze bushings can readily be redeemed by relining the interior with a good grade of Babbitt metal. The worn bushing is chucked in a lathe and bored to $\frac{1}{8}$ in. larger than the shaft. The bore should be rough and the size is not important. This bore is then tinned by using solder and soldering paste heated with a blowtorch.

After it has been tinned, stand it upright on a metal plate and place in its center a piece of smooth steel a trifle smaller than the shaft, as shown in Fig. 8. Clamp the steel piece upright and center the bushing. Then heat the bushing with the blowtorch and drop pieces of Babbitt metal into the cavity. The metal will melt and upon cooling, the babbitt and bronze will be knitted by the tinned surface. When cool, knock out the mandrel, chuck the bushing in a lathe, and ream to proper size.



Fig. 6. Screwdriver bit

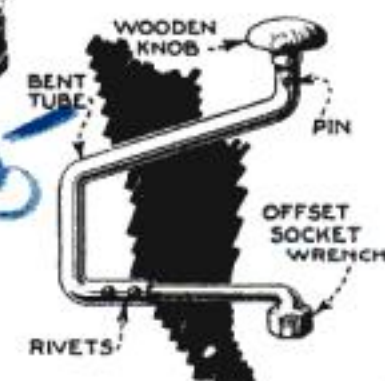


Fig. 7. Wrench handle

INDIRECT daylight can often be utilized in dingy rooms to improve working conditions for draftsmen or mechanics who have to depend upon their eyes a great deal. This was accomplished by one engineering company by silvering 15-in. wide strips of plate glass and placing them on the window sills so as to reflect daylight against the ceiling, which was enameled white. The walls were repainted a lighter color and the improvement was such that artificial lights were unnecessary the greater part of the day.

AN OPENING die can be used in an emergency to clear the burrs off the damaged threads on hardened or semi-hardened shafts. An ordinary die will not do the work because it is difficult to start it, but by placing the open die over the end, closing it on the good threads, and then backing it off, the damaged threads can be cleaned.

FOR removing broken studs and bolts, a special tool can be made from a left-hand twist drill, ground to a taper to give the sides a small amount of clearance. The end is cut square and then annealed, rehardened, and drawn until it has become a light blue.

Drill a hole into the broken stud large enough to allow the tool to be started and then run it in with a tap wrench until it takes a grip.

"THE AIR IS FULL OF THINGS YOU SHOULDN'T MISS"



Eveready "Three"
4½ volts, three distinct uses.
Length, 4 in.; width, 1¾ in.;
height, 3 in.; weight, 14 oz.
At all reliable radio dealers

This "C" Battery is a Wonder Worker

YOU can make the loud speaker respond with a new fullness and naturalness of tone. You can save money by adding months to the life of your "B" Batteries. These things you can do by using the new Eveready "Three" as a "C" Battery.

You already have an "A" Battery for the filament and a "B" Battery for the plate. A "C" Battery is connected to the third element of your vacuum tube, the grid, affording a control that is marvelous in action on audio frequency amplifiers.

As a "C" Battery the Eveready "Three" prevents distortion and excessive flow of current from the "B" Battery, lengthening its life. It is a wonder worker that saves its small cost many times over. Connect it in your audio frequency amplifier and note the difference. Full direc-

tions on the label and in "How to Get the Most Out of Your 'B' Battery," a booklet on "B" and "C" Batteries, sent free on request.

This triple-use battery can also be used as an "A" Battery in portable sets. Light and full of pep. Its third use is as a "B" Battery booster.

Use the Eveready "Three"—a tested product of the world's leading electrochemical battery laboratory. It serves more radio uses and effects more economies than any radio battery heretofore developed.

If you have any battery problem, Radio Battery Information Headquarters will solve it for you. Write G. C. Furness, Manager, Radio Division, National Carbon Company, Inc., 116 Thompson Ave., Long Island City, New York.

NATIONAL CARBON COMPANY, INC., New York—San Francisco

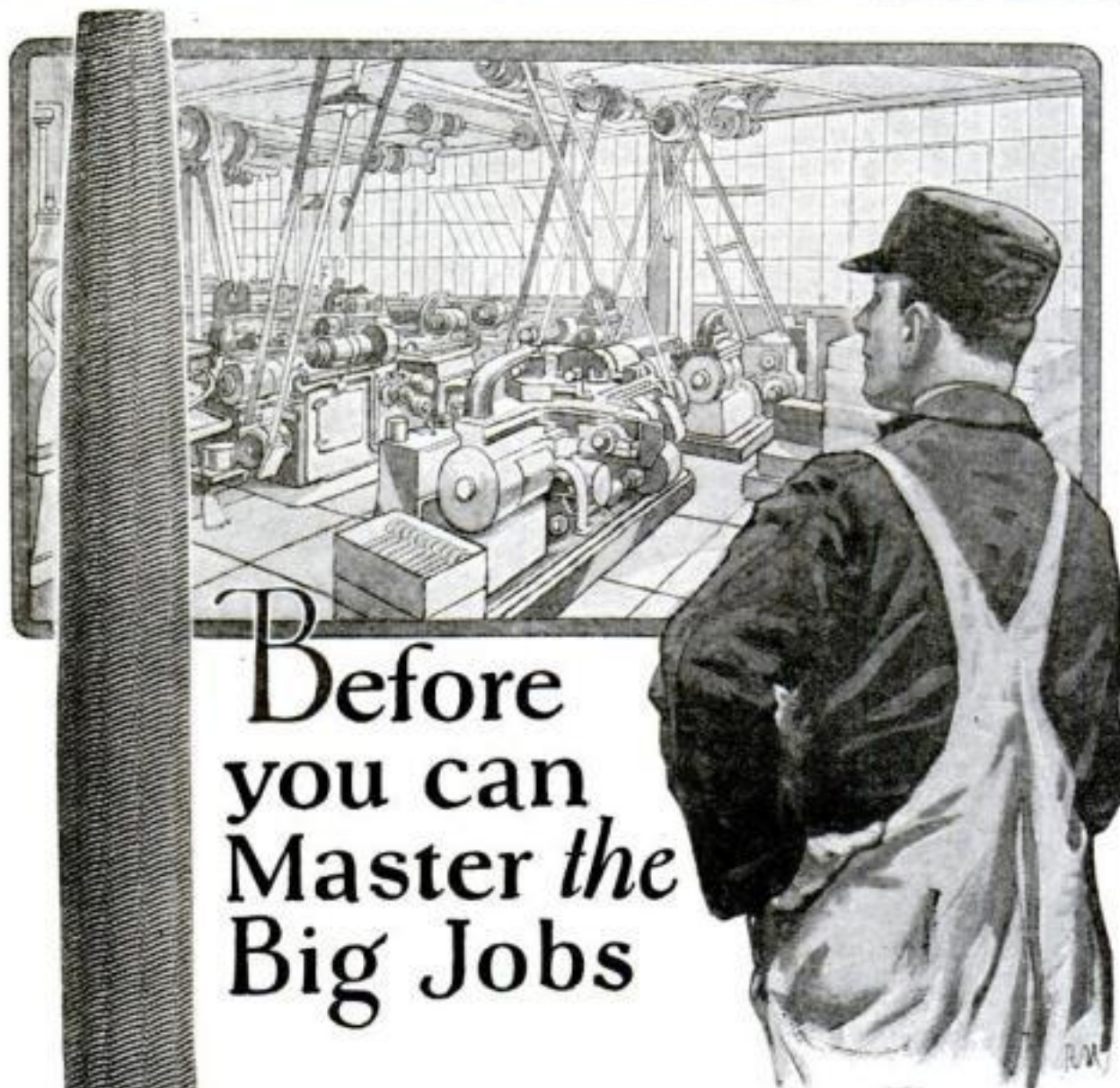
Headquarters for Radio Battery Information

CANADIAN NATIONAL CARBON CO., Limited Factory and Offices: Toronto, Ontario

EVEREADY
Radio Batteries
—they last longer

NICHOLSON FILES

~ a File for Every Purpose



Before
you can
Master *the*
Big Jobs

So much depends upon good files and proper methods of using them, that every young mechanic should master the art of filing as a necessary step to the job above.

Among the thousands of kinds of NICHOLSON Files, there's a file for every purpose — which, because of extra sharpness, greater uniformity and longer life, assures better results.

Take your Hardware Dealer's tip—he knows which NICHOLSON Files you need. And NICHOLSON Files are all ready to go to work, requiring no breaking in.

NICHOLSON FILE CO.

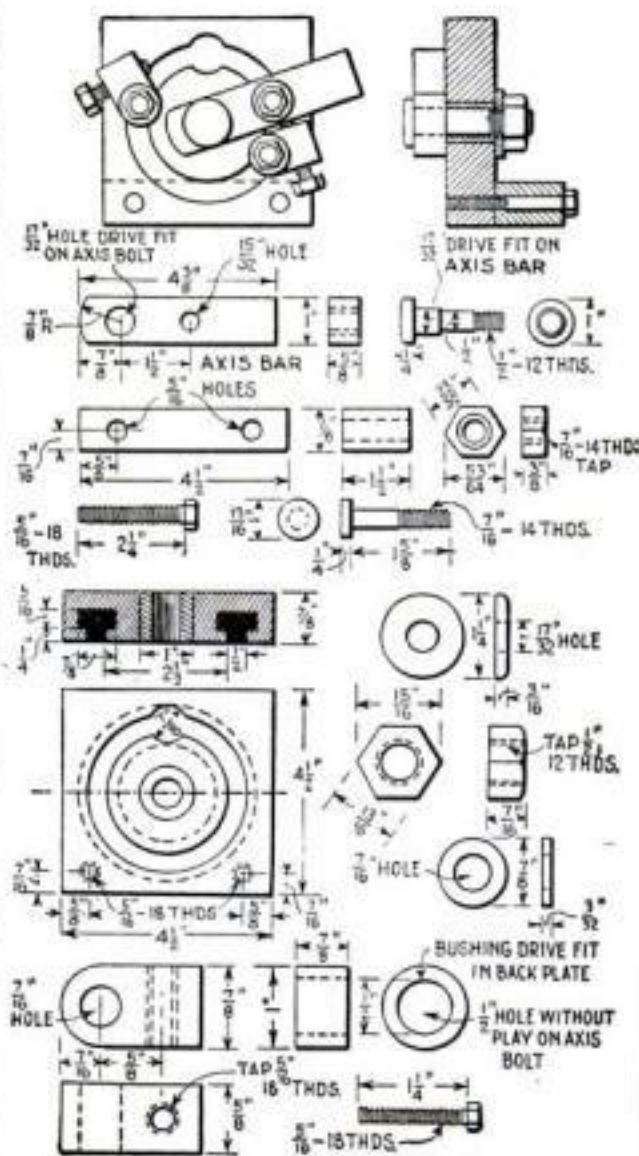
Providence, R. I., U. S. A.,

NICHOLSON
U.S.A.
(TRADE MARK)

Angular Dresser Saves Time in Truing Grinder Wheels

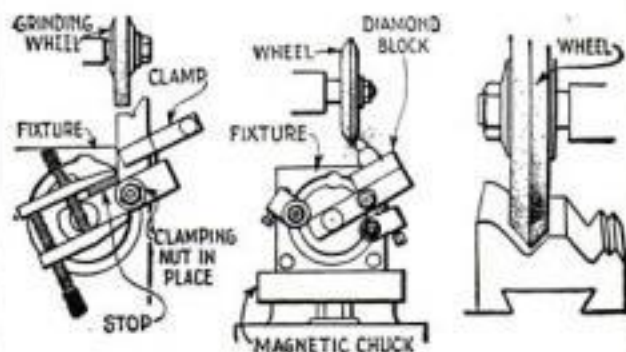
IN THE average shop not equipped with means for dressing angularly the wheel of a surface grinder, the usual method is to clamp a parallel to an angle iron and run the diamond block up and down on this. Not only is the accuracy difficult to obtain by such a method, but it is a tedious job.

By constructing the fixture illustrated, the operation of dressing wheels is simplified materially.



Details of base, back plate, axis bar, adjusting fixture, and the necessary bolts

The top and sides are made square so as to permit the use of a bevel protractor for setting the axis bar. The axis bolt, which is forced into the bar in a press, is made so as to fit the bushing in the back plate tightly. Whenever the joint becomes too loose to remain fixed, the bushing can be renewed. The T-slot



Grinding duplicate pieces and dressing an angular wheel to finish a forming tool

passing through the axis bar is utilized for clamping after fine adjustments are made by means of the adjusting fixture screws. For fine work the fixture can be set by means of a sine bar.

The whole fixture, excepting the axis
(Continued on page 94)

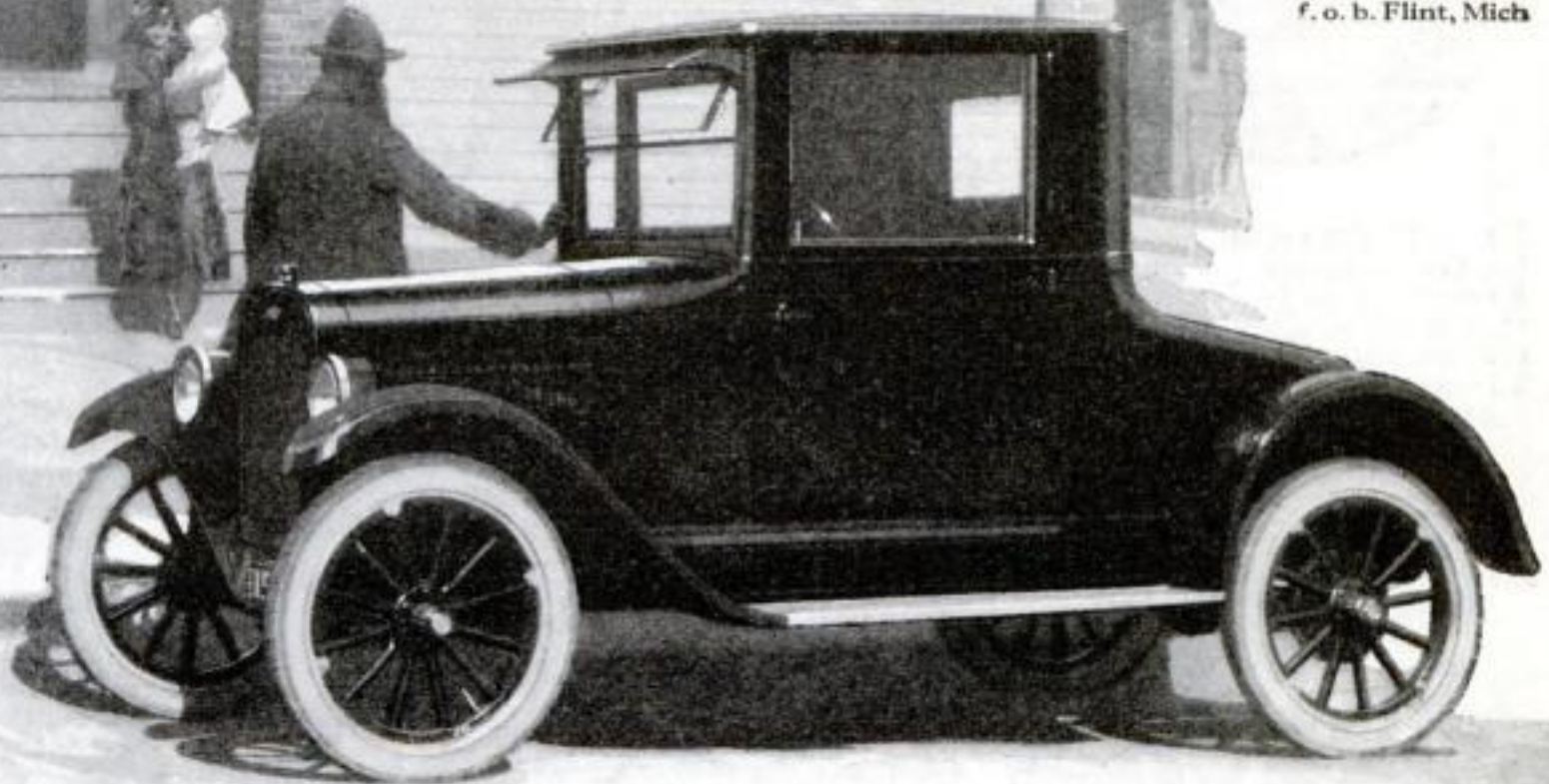
for Economical Transportation



Superior
Utility Coupe

\$640

f. o. b. Flint, Mich



For The Small Family

The world's lowest priced high-grade closed car exactly meets the requirements of the small family.

Father uses it daily going back and forth to work. Evenings and Sundays it holds the young family comfortably, protecting baby from winds, storms and cold in winter, and yet

it has all the airiness of an open car in summer.

The plate glass windows are extra large. The wide doors make it easy for mother to enter or leave with baby in her arms.

Finally, and most important, its low price and low maintenance costs make it feasible for the family of modest income.

Chevrolet Motor Company, Detroit, Mich.

Division of General Motors Corporation

Prices f. o. b. Flint, Michigan

Superior Roadster - - -	\$490	Commercial Cars	
Superior Touring - - -	495	Superior Commercial Chassis	\$395
Superior Utility Coupe - -	640	Superior Light Delivery -	495
Superior Sedan - - -	795	Utility Express Truck Chassis	550

Dealers and Service Stations everywhere. Applications will be considered from high-grade dealers only, for territory not adequately covered

The United States manufacturing plants, seven assembly plants and Canadian plants give us the greatest production capacity in the world for high-grade cars and the possible our low prices.



Mr. B. M. Oliver, of St. Louis, Heating Expert, has invented a New Kind of Heat which gives Three Times the Heat of Coal.



DON'T BURN COAL!

Amazing New Invention Does Away With Dirty Coal and Wood. Gives Three Times the Heat in Any Stove or Furnace

NO longer is it necessary to pay exorbitant prices for coal and wood—or to face the uncertainty of actual coal strikes and shortages. No longer is it necessary for any woman to give her best strength and energy in endless back-breaking servitude to a hot, mussy heater, cook stove or furnace.

No more dirty, heavy coal and wood to carry and lift—no more clouds of ashes to breathe or back-breaking scuttles to empty—no more fires to build, bank or watch—no more heat-

ing problems—no more cold rooms in Winter—no more frozen, bursted furnace pipes—no more suffering from lack of quick fires in uncertain Fall and Spring—and no more worries about coal shortages, poor quality or high prices. An amazing invention ends all this forever and makes any type of cook stove, heater or furnace, an automatic heater that can be regulated to any temperature by simply turning a valve. The wonderful invention of Mr. B. M. Oliver, fuel expert of St. Louis, has now been perfected so that there is a model that can be installed in any coal or wood stove in one

minute's time, and then actually gives 3 times the heat of coal if wanted—or can be regulated to a tiny flame by the simple turn of a little valve. And at a cost any family can afford, any hot air, hot water or steam furnace can be converted into an automatic oil burning plant, without noisy motors, without electrical connections, without any moving parts.

Cheap, Clean, Simple

Mr. Oliver calls his invention the Oliver Oil-Gas Burner because it uses 95% air and only 5% oil (the cheapest fuel there is), turning them into an actual gas that burns with

an intensely hot, clean flame. No wicks, no smoke, no odor.

Fits All Stoves Without Change

Mr. Oliver's wonderful invention is made in 16 models to fit any kind of cook stove, heating stove or furnace. No holes to drill, no bolts to fasten, no changes whatever. Simply sets in firebox. Absolutely safe. It lasts a lifetime.

No wonder housewives are clamoring for this wonderful device. No wonder Mr. Oliver receives letters like these: Mrs. W. N. Spencer, of Conn., writes, "The Oliver in my heating stove works like magic. It is wonderful to have quick heat and no work." Mr. Elijah McCleave, of Va., says, "It works fine. All my friends want one. I will get their orders." A letter from Mr. S. K. Pedro, of S. Carolina, says, "Beats all other burners seen in this country. A sensation." Mr. George Flynn, of Michigan, writes, "It is cleaner, cheaper, hotter and steadier than coal or wood. Only cost me \$5 for two months."

Perfect Heating Guaranteed

Now, once and for all times, do away with household dirt

and drudgery. The Oliver in your stove, heater or furnace saves hours of work, thousands of needless steps. Already Oliver burners are installed in over 150,000 homes. Their performance has been so thoroughly tested that Mr. Oliver will absolutely guarantee perfect heating for any Oliver burner you install.



The Oliver burner makes any range a gas stove—on and off at turn of valve—much or little heat as desired.

Coupon Brings Free Low Price Introductory Offer

Send immediately for the Free Attractive Booklet, "New Kind of Heat," which tells all about this amazing new invention, shows exactly how it works and how it is different from all other burners.

The coupon below will bring you this information absolutely free, without obligation. And if you mail the coupon at once you will be in time to receive Mr. Oliver's very Low Introductory Price. You should have your Oliver installed immediately. By acting quickly, by sending in your

name at once you will be entitled to Mr. Oliver's Special

Low Price whether you buy now or later. So get this coupon in the very first mail.

Agent Makes \$215 in One Day—More Agents and Distributors Wanted

Mr. Oliver is also looking for agents, salesmen and distributors. Oliver agents are making fortunes. F. B. Bentley, of Phila., says, "Ye gods! some seller. I made \$215 today." J. Carnegey, S. Dakota, writes, "Making \$1,000 a month." A. M. Russell, Conn., \$258 per week. Mrs. Selder, Kans., made \$100 a month, spare time only, in her own home.

If you want to earn \$50 a week spare time, or \$200 a week full time, write for FREE Sample Case Sales Plan. If you can swing a whole territory and want \$15,000

to \$50,000 and more a year, wire for sales plan. Address Mr. Oliver personally at address below.

OLIVER OIL-GAS BURNER CO.
B-54 Oliver Building, St. Louis, Missouri

Canadian Distributor
B-54 Oliver Bldg., Toronto, Ont.

"Oldest and Largest Manufacturers of Oil-Gas Burners in the World."

It Brings Free Low Introductory Price Offer!

OLIVER OIL-GAS BURNER CO.,
B-54 Oliver Bldg., St. Louis, Mo.

Gentlemen: Send me your free book, "New Kind of Heat," and your Special Low Price Introductory Offer. I am interested in a burner for

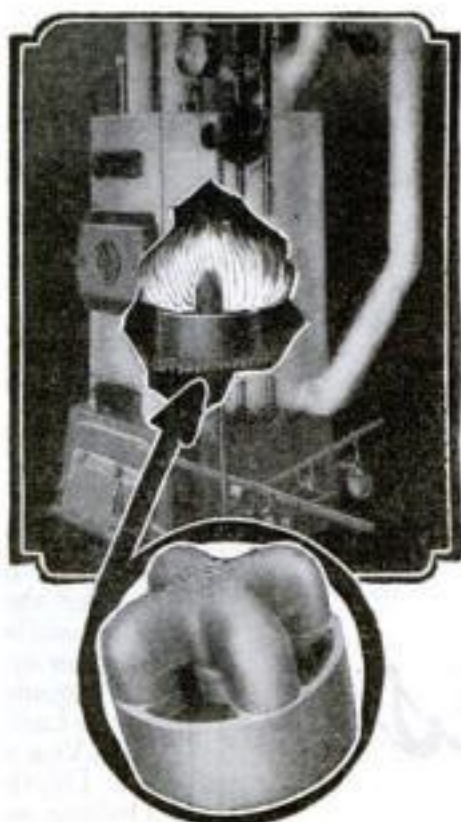
☐ Coal Range ☐ Heating Stove ☐ Furnace
(Specify Steam, Hot Water or Hot Air)

Name

Address Co.

City State

☐ If interested in selling in full time or spare time check in square here.



Fits all types of Hot Water, Hot Air or Steam furnaces, without changes to your present plant.



Be Sure of a Beautiful Finish



Linduro Enamel
Vernicol Stain
Automobile Color
Neptunite Varnish

With these four splendid products in your house you will be prepared to put a permanently beautiful finish on any piece of work you may make. The Lowe Brothers Dealer in your town can supply you with one or all of these products.

When the manual labor is done on a medicine chest, table, swing, flower-box, or any useful article for the house that your hands have contrived—when it is time to apply the finish—then choose wisely so that the finish will enhance the beauty of your handiwork.

And whether you want to finish the piece with varnish, stain or enamel, you will find among Lowe Brothers Paints and Varnishes a product expressly made for that purpose—a product that you can be sure will produce a finish of lasting beauty.

For fifty years Lowe Brothers Paints and Varnishes have been used by the amateur workman and craftsman furniture finisher. There is one dealer in your community—The Lowe Brothers Dealer—who can supply you with these famous products.

Visit this dealer. He will not only supply you with a specifically prepared paint or varnish, but he will give you expert advice as to how to use it.

THE LOWE BROTHERS COMPANY
Dayton, Ohio Factories Toronto, Canada
BRANCHES IN PRINCIPAL CITIES

Lowe Brothers
PAINTS & VARNISHES

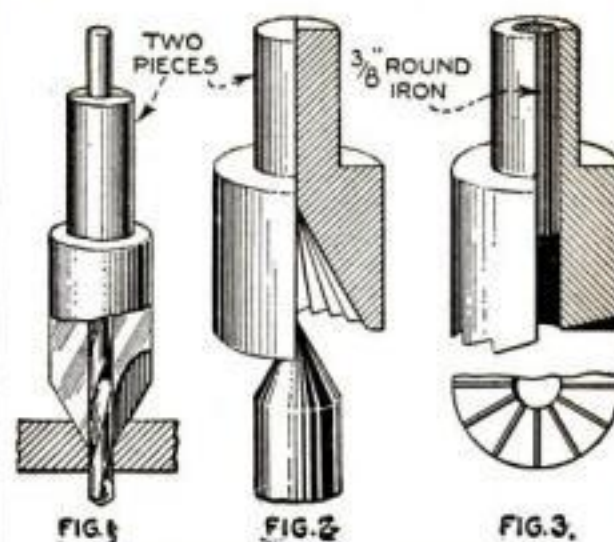
Angular Dresser Saves Time

(Continued from page 90)

bolt, is left soft and must be ground all over. The T-slot is cut on a milling machine by means of a circular attachment or it can be done on a spiral head. The back plate and base plate can be either cast iron or machine steel.—HENRY S. LARABY.

Special Reamers and Cutters Constructed in Two Parts

SPECIAL reamers are often useful in the machine shop. Figure 1 shows a tool for drilling and countersinking at one operation. A piece of round steel is shouldered at one end, drilled through the center to fit the drill, and cut in half through the center. It will accommodate three sizes of drills, such as 3/16, 7/32, and 1/4 in. A cutting bevel is ground on the edges of the reamer and the drill and



A drill and countersink, a cutter for pointing rods, and an end mill

reamer are clamped together in a drill chuck. The split reamer adds to the rigidity of the drill and reduces breakage.

Figure 2 shows a two-piece pointer that would be difficult to make in one piece. Before making the cutting edges the reamer is cut in half, and each piece is finished separately.

An end mill—also made in two sections—is shown in Fig. 3. A hole passes down through the center of the tool into which an iron rod of any desired length may be placed to space the halves properly. When working on tenons that are to be finished at a definite length, the rod will act also as a stop.—O. W. MIELENZ, Philadelphia, Pa.

On Next Month's Schedule

AN INSPIRING article on success in the shop, by M. E. Duggan, one of the best known pattern-makers in the United States.

W. Burr Bennett, an automotive engineer, describes a connecting rod reamer that is useful for the small automobile repair shop.

Other articles of practical value to the shopman will be "Making Inserted Blade Lathe Tools," "Fitting a Small Tool Vise with a Dual Purpose Base," "A Depth Gage for Simultaneous Drilling and Spot Facing," and "A Hammer Impact Key Puller."

"Making the Most of Boring Tools" and "What a Machinist Should Know about Hardening," are two longer features scheduled for early publication.



Get this, men—

A complete assortment of the world's finest smoking tobaccos — sent to any smoker anywhere — *on 10 days approval*

A new idea for Pipe-Smokers: 12 famous tobaccos, packed in a handsome Humidor—shipped to you direct to help you find the soul-mate for your pipe.

GUARANTEED BY

The American Tobacco Co.

MOST men have written their John Hancocks on a lot of "dotted lines." But, if you're a pipe-smoker, we'll wager that you've never signed a fairer, sweeter contract than the little coupon at the bottom of this page.

Just a few strokes of your pen—and you can end your quest of years for a perfect smoking tobacco—drawing dividends for life in unalloyed pipe-satisfaction.

But we are getting ahead of our story.

The average pipe-smoker is the greatest little experimenter in the world. He's forever trying a "new one," confident that some day

he'll find the real affinity for his pipe.

Knowing smokers as we do—and knowing tobaccos as we do—we felt that we'd be doing a friendly turn for everybody if we found a way to settle this question once and for all, to the satisfaction of every smoker.

So we created the *Humidor Sampler*.

Into a bright red lacquered humidor case, we have packed an assortment of twelve famous smoking tobaccos—covering the whole range of tobacco taste.

To test these 12 tobaccos is to go the whole route in delightful pipe tobacco experience, trying out every good flavor and aroma known to pipe connoisseurs.

There are myriads of different brands of smoking tobaccos on the market. But of them all, there are 12 distinctive blends which, in our opinion, stand in a class by themselves for superlative individuality of flavor, aroma and smooth, sweet, even quality.

These twelve decisive blends—the twelve "primary colors" of tobaccos—have been selected for the Humidor Sampler. When you have tried these twelve, you have tried the best;

if your tobacco-ideal is to be found anywhere, it must be one of these.

Ten-Day Approval Offer

We are eager to send the Humidor assortment to any smoker, anywhere, on ten days' approval.

Send no money. Just sign and mail the coupon. That will bring you the Humidor assortment direct from our factories to your den. When the postman brings the package, deposit \$1.50 with him, plus postage.

If a ten-day try-out of these tobaccos doesn't give you more real pipe pleasure than you've ever had before, besides revealing the one perfect tobacco for your taste—the cost is on us.

Simply return the Humidor, and you'll get your \$1.50 and the postage back *pronto*—and pleasantly. The coupon is your obedient servant; use it.

Send No Money—Just Mail Coupon

The American Tobacco Co., Inc.
Marburg Branch, Dept. 37
Baltimore, Md.

Please send me, on 10 days' approval, one of your Humidor Samplers of twelve different smoking tobaccos. I will pay postman \$1.50 (plus postage) on receipt—with the understanding that if I am not satisfied I may return Humidor in 10 days and you agree to refund \$1.50 and postage by return mail.

Name

Address

Note:—If you expect to be out when postman calls you may enclose \$1.50 with coupon and Humidor will be sent to you postpaid.

A \$3.05 Test for \$1.50

If you were to try all 12 of these tobaccos in full size packages, the cost would be:

Blue Bear	.25
Capitan	.30
Imperial Cube Cut	.30
Imperial Cube Cut (1941)	.30
Old English Curve Cut	.15
The Garrick	.30
Carlton Club	.15
Yale Mixture	.25
Three States	.25
Lane Jack	.10
Willi Latakia	.45
Louisiana Triquet	.25
Total	\$3.05

But through the Humidor Sampler you get a liberal "get acquainted" quantity of each for \$1.50



Another Popular Pexto Item—
Samson Ratchet Bit Brace with
Ball Bearing Chuck and Head.

Good Tools Make Good Work Easy—



No. 30 Box Joint Plier

Drop forged steel, raised cutters, square opening in back, perfect fitting joint, easy action.



1819 Original Snip

Forged from best grade steel, they have given satisfaction for over one hundred years



No. 91 1/2 Hammer

Drop forged steel, heat treated and tempered, excellent finish and properly balanced.



No. 3 Solbar Screw Driver

Forged steel bar runs entire length. Fluted hardwood handle securely held.

To take pleasure in your work you need good tools, tools that will do the job required of them.

PEXTO Tools are backed by over a century of tool making experience. They are of first class quality and fully guaranteed.

The line consists of Bit Braces, Auger Bits, Squares, Chisels, Hammers, Hatchets, Pliers, Monkey and Pipe Wrenches, Angle Wrenches, Screw Drivers, Snips, Compasses, Pruning Shears, Dividers, Calipers, Pincers, Soldering Coppers, Nail Sets, and many other small tools.

Booklets covering our important lines are available for free distribution.

PEXTO TOOLS are carried by practically all progressive dealers.



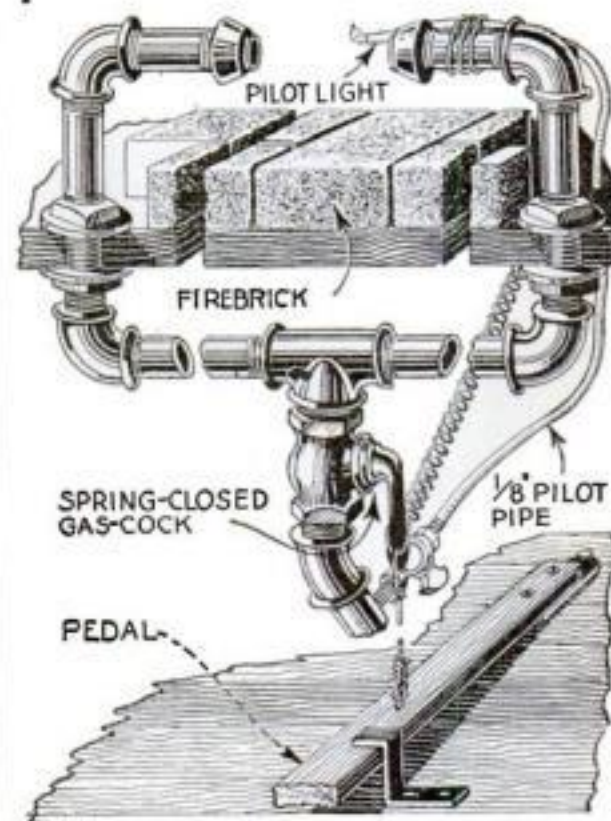
WORTH WHILE TOOLS

The Peck, Stow & Wilcox Co.
Southington, Conn., U. S. A.

Shut-Off Pedal and Pilot Light Improve Shop Blower

THE blower in a shop is usually the cause of much annoyance, either because the gas is turned on when not in use, thereby causing waste, or because it is out and matches are not handy for lighting it.

By attaching a pilot light and pedal control to it, as illustrated, this waste and delay are eliminated. A spring is attached to the handle of the cock, as shown, to hold it closed, and a wire is led



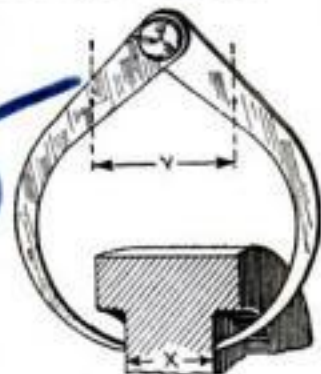
To turn on this blower, the pedal is pressed down and caught under the bracket

from the handle to a pedal. By pressing down the pedal and hooking it under a bracket on the floor, the gas is allowed to flow to the burner. When the pedal is released, the spring closes the cock.

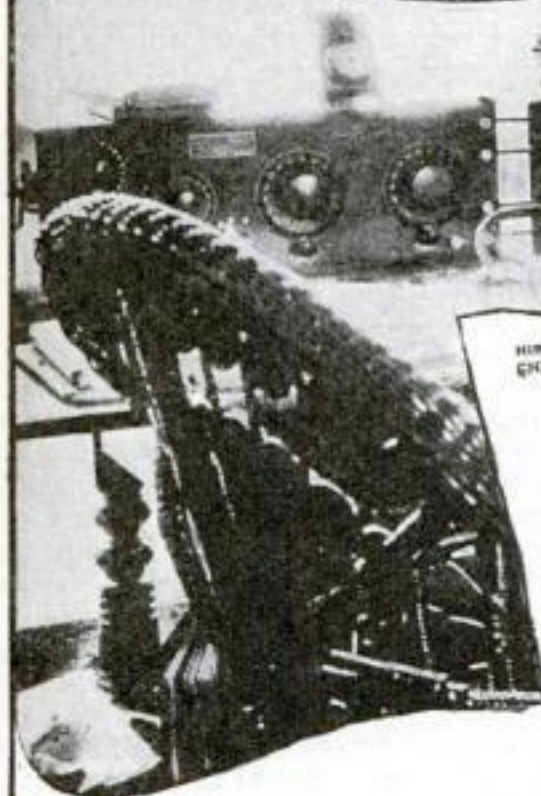
A pilot light is led out to the nozzle from the gas pipe in rear of the main supply cock. A small cock in this line regulates the amount of gas flowing to the pilot at all times so that there is always a flame available when the blower is needed.

Calipering Flanged Work

AN EASY way to measure the thickness of a web difficult of access is that illustrated. First, make prick punch marks on the legs of a pair of outside calipers, as shown. Pass the points over the flange and set them against the surfaces of the web. Then scale the distance Y. Now remove the calipers, move the legs together until the punch marks are Y distance apart, and the distance between the points will represent the thickness of the web X.



DUST on a concrete floor can be prevented by painting it, when perfectly dry, with boiled linseed oil thinned with gasoline. Several coats should be given until the surface is glossy.



MacMillan's Link with Civilization

A Paragon Radio Receiver is the most dependable link between MacMillan's courageous explorers and a civilization eager to hear of their doings.

Read this letter from Jack Barnsley whose Paragon Receiver has been picking up these vitally important messages, picking up every one, and getting every word clearly.

A Radio Receiver could have no higher recommendation.

Illustrated Bulletins on Paragon Radio Products are yours for the asking.

ADAMS-MORGAN CO.,
18 Alvin Avenue,
Upper Montclair, N. J.

HIRSH PERCY MAXIM, PRESIDENT
CHAS. H. STEWART, VICE-PRESIDENT

F. H. SCHNELL, TRAFFIC MANAGER

A. A. HERBERT, TREASURER
K. B. WARNER, SECRETARY

THE AMERICAN RADIO RELAY LEAGUE

EXECUTIVE HEADQUARTERS
HARTFORD, CONNECTICUT

OFFICIAL ORGAN: QST
KENNETH B. WARNER, EDITOR

Experimental Radio Station 9BP
Prince Rupert, B. C. Canada.
September 26th, 1923.

Messrs. Adams Morgan Company
Upper Montclair, N. J.

Dear Sirs:-

I have advised you before that I am very pleased with the results of my "PARAGON APPARATUS" but here is another victory for "PARAGON APPARATUS" which I feel you will be interested to know.

The MacMillan Arctic Expedition which left Wiscasset, Maine on June 23rd. on board the radio equipped Schooner "Bowdoin" planned to keep in touch with the outside world by amateur radio. This they were able to do until they got North of Disco Island, Greenland. After going North of that point nothing was heard of the expedition. And all interested became worried at the ship's apparent silence. The Chicago Radio Laboratory on this account offered a duplicate of the receiving apparatus aboard the "Bowdoin" as a prize to the first amateur to get into communication with the Arctic Expedition. This prize I have had the honor to win with the aid of my PARAGON Type RA-10 Regenerative Receiver and PARAGON Type DA-2 Detector-Amplifier.

Since first getting into communication with the "Bowdoin" expedition (who are in winter quarters frozen in at Refuge Harbor, which is ten miles North of Greenland Latitude 78.30 North, Longitude 72.30 West) on September 7th. I have had a working schedule with the operator and have copied one 600 word and one 181 word press message from them addressed to the New York World, together with dozens of private messages from the expedition and a complete list of amateur calls heard (a total of 546 calls) by the "Bowdoin" from July 28th to September 20th. and have forwarded all of these messages to their destinations.

When you consider that the expedition has heard hundreds of amateur stations in the Arctic but that my station has been the only one with whom they have been able to communicate, I consider this quite a record for "PARAGON APPARATUS" and am glad to be able to advise you how proud I am of my receiving apparatus.

Yours very truly

Jack Barnsley

Then and there He was Convinced—



There was a mechanic who said he could get other tools than "Brown & Sharpe."

He Could

He said, "I'll try a new Micrometer of another make."

He Did

He thought that this other tool would be just as reliable as a Brown & Sharpe.

It Wasn't

His work was not as good—and the tool was to blame.

He was dissatisfied

Finally he made up his mind to buy a Micrometer that he *knew* he could rely on—and it was a Brown & Sharpe.

He has used it ever since

BROWN & SHARPE TOOLS

are made in the largest factory of its kind—their accuracy, improved design, long life and quality have made them the "Standard of the Mechanical World."

Catalog listing over 2,000 different tools, with discount sheet, sent on request. Send for it today.

BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I., U. S. A.

Success with Taps and Dies

(Continued from page 86)

a tap will cast up and burr the metal so as to make practically a full thread even though a small allowance on tap or die diameter has been made.

It is essential that the right kind of tap be used for a particular job. Taps are made with two, three, and four flutes in the smaller sizes and six or eight flutes for the larger diameters. For extreme accuracy a gun tap, with only two flutes, should not be used, but occasionally a gun tap will work well on a difficult, rough job. The effect of the various kinds of taps on different work should be studied. Spiral fluted taps clean out the chips nicely and all other taps should have proper hooks on the cutting teeth to afford chip room.

Accurate Taps Essential

Most careful workers have their own particular set of taps which they keep standard on the leading teeth and maintain with a back taper. Such taps pull easily and cut accurately, while a tap with a reverse taper will choke and pull hard, making an imperfect thread. Such mechanics never use a tap or die with broken teeth except in an emergency and then only after the teeth have been ground down. Neglect to grind the broken teeth almost always results in torn threads.

There are occasions where even a damaged tap or die is not available. Lucky is the man who in this emergency can speedily make a tap for finishing a rush job.

In making either taps or dies, tool steel of the best grade should always be used.

For a plug tap a piece of steel of the proper width and length is cut off, chucked in a three-jaw scroll chuck and filed tapered for a distance of about three threads at the lower end. From that point it is back tapered (smaller at the shank) about .001 in. an inch. If a lathe is not available, the taper must be made as nearly correct as possible by hand.

The thread is then cut with a die opened up a small amount, and a second cut is made with the die set at the actual size. Soda water or compound is used as a lubricant so as to obtain a high polish on the finished surfaces of the threads.

Finishing and Hardening Taps

After deciding on the number of flutes, take a three-cornered file and gash them in roughly. A round file should then be used to finish the flutes accurately. In this way the flutes can be made deepest at the lower end, running shallow at the junction of the thread and shank. The tapered or chamfered threads at the lower end are backed off and a flat or square is filed on the end of the shank for the tap wrench.

The tap is now ready for hardening. Hold it in a hot flame (Bunsen burner) and heat to a bright cherry red. Then quench it in lukewarm or cool water, dipping the tap in vertically and stirring in circles, beginning with the smallest rotary motion possible and gradually increasing the circles. In this way all

(Continued on page 100)

Tycos

Temperature Control

THE SIXTH SENSE OF INDUSTRY

WHEN the farmer's wife spun her own yarn and then wove the cloth, the human sense of feeling was sufficiently accurate for deciding when the wool had the right amount of "moisture content" to be made into yarn.

But with the development of wool manufacturing on a large scale—and all the allied textile industries—the human sense of feeling had to be replaced with something more accurate—something infallible.

This infallible sense so essential to the textile industry—the second greatest industry in the country—has been found in Tycos—the sixth sense of industry.

No longer is the dyeing and preparing of wool, silk, cotton and linen for manufacturing purposes dependent on the workman testing the "moisture contents" of these materials by feeling them.

By supplying a scientific and exact method of determining temperature and moisture contents Tycos Temperature Instruments have reduced to an exact science the conversion of animal and vegetable products into textiles.

In every manufacturing process Tycos Instruments for Indicating, Recording and Controlling Temperatures have taken the guess out of manufacturing. The use of Tycos Instruments insures the uniformity of results that is necessary to success in manufacturing and selling on a large scale.

Manufacturers

What do you make? What is your problem of applying Tycos "the sixth sense" to your manufacturing processes. For every process—in any industry—requiring heat control there is a type and style of instrument in the Tycos line that you need.

Write us and literature on any instrument or type of instrument will be sent you promptly. Or, if you prefer, our experts will advise you in the application of "the sixth sense" in your plant.

Canadian Plant
Tycos BUILDING
TORONTO

Taylor Instrument Companies
Main Office and Factory
ROCHESTER, N. Y., U. S. A.



Tycos in the Home

Tycos Office Thermometers
An aid in promoting human efficiency.

Tycos Bath Thermometers
To enable you to get the most good from your bath.

Tycos Home Set
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Tycos Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

Tycos Quality Compasses
To show you the right way in unfamiliar country.

Tycos Fever Thermometers
A necessity in every home.

Tycos Stormoguide
Forecasts the weather twenty-four hours ahead with dependable accuracy.

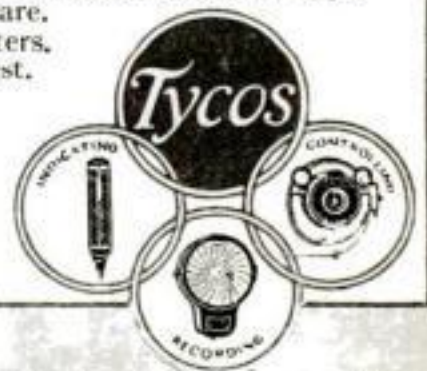
The
SIX SENSES
✓ Feeling
Seeing
Hearing
Smelling
Tasting
and
Tycos
Temperature
Control

Tycos Hygrometer
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Tycos and the MEDICAL Profession

Tycos Sphygmomanometer, Pocket and Office type
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.
Bulletins on request.



Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING

No. 677
RATCHET
BREAST
DRILL

Try this light-weight breast drill

See how easy the two-speed ratchet mechanism works. Changes of speed and changes of motion are made by a turn of a dial. Frame of aluminum alloy. Holds round-shank drills 0 to $\frac{1}{4}$ inch.

The Goodell-Pratt catalog describes each of the 1500 Good Tools. Write for it—free.

Goodell-Pratt Company
Greenfield, Mass., U.S.A.

Toolsmiths

Makers of Mr. Punch

GOODELL- PRATT

1500 GOOD TOOLS

Success with Taps and Dies

(Continued from page 98)

sides of the piece will cool evenly without warping the metal.

The tap will then be as hard as glass and must be tempered. Hold the tap with a piece of wire, one end of which is wrapped around the threads, and pass the whole length of the tap through the flame, allowing the shank end to get the most heat. The shank will first turn yellow and then a straw color, the color going down toward the threaded portion. This can be observed best if the shank and the inside of the flutes are polished. When the end of the tap shows a straw color, quickly dip it in cold water. Taps hardened and tempered in this way will have hard cutting edges and tough shanks and bodies. —

The general method of making tapered and bottoming taps is the same as for the plug taps described. The difference lies in the tapering of the blank. The tapered tap has the lower end turned straight for three threads, then tapers for six threads and is straight except for a .001-in. back taper the rest of the way. The bottoming tap has a chamfer on the lower thread only.

Steps in Making Dies

When making dies, a layout five or 10 times the size of the actual tool should be made first. This diagram then is reduced to actual size and traced on the blank. Before laying out on the blank, the latter should be sawed and faced on both sides to the thickness required.

The first holes drilled are the chip clearance holes. These then are plugged tightly with soft steel plugs, each one being a driving fit. The central hole is drilled then and reamed to size, taking care that the diameter agrees absolutely with the root diameter of the thread.

The chamfer of the lower end should taper out in three threads, while that on the upper end includes one thread only. The die then is tapped with a taper tap starting at the bottom or tapered side of the die. Lard oil provides a good lubricant for this operation. The finishing cut should be made with a bottoming tap.

A weakening hole next is drilled and the saw slot is cut from the inside, leaving a thin bridge on the outer circumference for the purpose of holding the metal rigid during the hardening process and preventing the die from warping. This bridge is filed away when the die has been tempered.

Countersinks then are made in the saw slit and one side to receive the points of the side and set screws respectively. At this time the chip hole pins are driven out and the rear of the lands are backed off with a flat file. The hooks or lips of the cutting edges then are touched up and clearance is filed on both top and bottom chamfers.

The die is now ready for hardening. Wrap a piece of wire around the thin section of the die and heat the die to a cherry red. Quench as in the case of the tap and draw the entire die to a deep straw color. The temper can be improved

(Continued on page 102)

asleep or awake



they're always growing

Man's whiskers, like the troubles of people who live beyond their means, are always growing. Clocks may stop, lecturers may pause to consider, but, day and night, as long as he lives, man's whiskers are always growing.

—From "The Hair Apparent," Part I, Chap. IV.

□ □ □

ACCEPTANCE of the fact that a facial briar patch is not likely to contribute to a man's success in scientific pursuits, in business, in love, or in any other worthy endeavor is spreading rapidly.

Most professional men, as well as most business men, now shave daily. This is the only means of keeping man's always growing beard in proper subjection.

No matter how heavy your beard may be, or how tender your skin, you can shave closely every morning, and be comfortable, if you lather with Colgate's "Handy Grip" Shaving Stick. It makes shaving easy, and always leaves the face cool and refreshed.

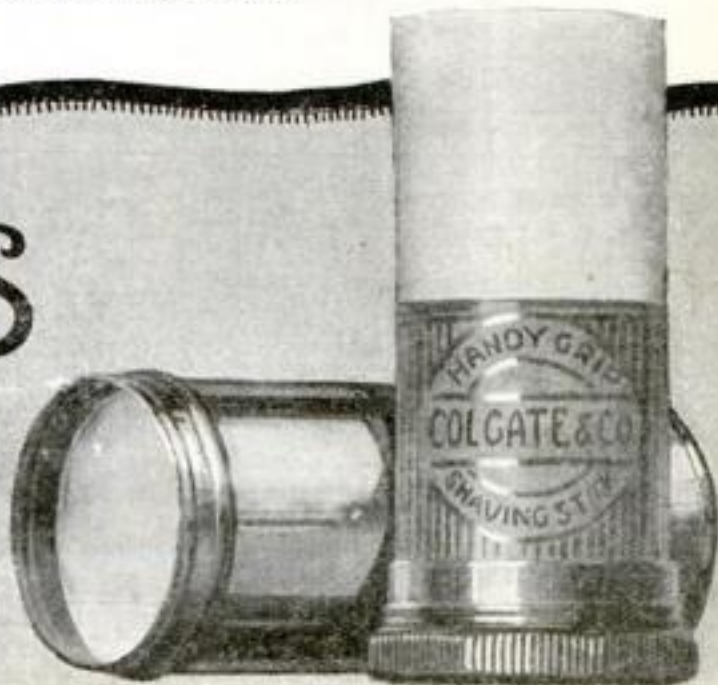
The "Handy Grip" and metal container will last for years. After your first shaving stick is used up you can buy Colgate "Refill" Sticks for the price of the soap alone.

It is not uncommon for a Colgate Shaving Stick to last for a year or more in daily use.

Colgate's "Handy Grip" Shaving Stick is unequalled for putting comfort, convenience, and economy into the daily shave.

COLGATE'S
Shaving Stick

"HANDY GRIP" AND REFILL





"That new hinged cap sure is a wonder"

Williams' Shaving Cream

Have you tried Williams' Aqua Velva? The new scientific formula for after-shaving use? Sample free. Write Dept. 102

The J. B. Williams Co., Glastonbury, Conn. The J. B. Williams Co., Ltd. (Canada), 1114 St. Patrick St., Montreal

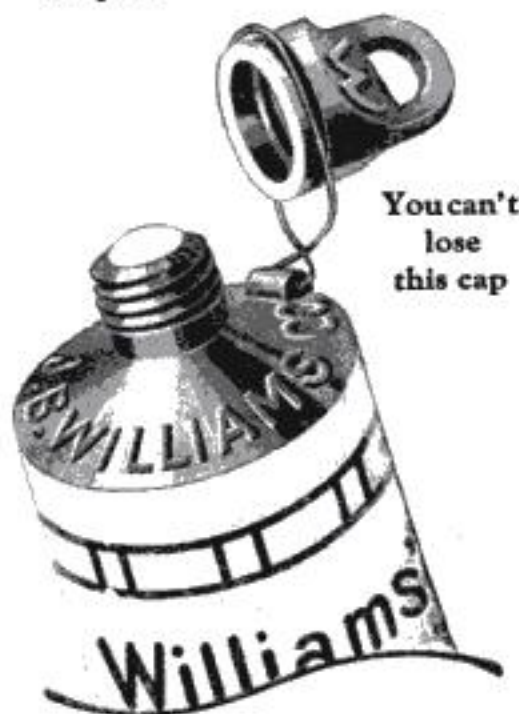
COMPARE the Williams' cap with any other. There's nothing like it. Compare Williams' in any and every other way:

You'll like its lather—uncannily swift in the way it softens tough beards. For years the envy of other shaving soap makers.

You'll like its purity—no coloring disguise is needed in Williams'. It is a natural white.

You'll like its soothing effect—no complexion soap in the world is more beneficial.

And last, there's the Hinged Cap! Add to your Williams' shave this "extra dividend" of a cap that you can't lose. Then compare.



Success with Taps and Dies

(Continued from page 100)

by repeating the operation several times.

The weak section of the die should then be drawn to a deep blue, taking care not to change the temper of the lands. The bridge is also drawn blue and is later filed away. The blue temper increases the tenacity of the steel and makes the weak section act as a spring.

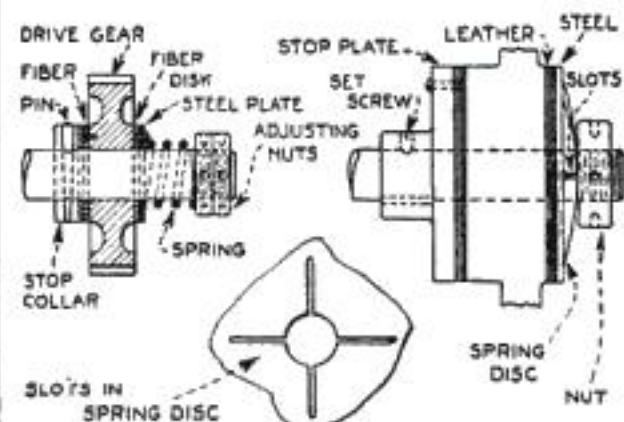
Correct proportioning of a die in relation to chip room, lip angle of the cutting edges, and the proper backing off of the chamfered portion of the thread are highly important features in the making of successful cutting and wearing dies.

All small taps and dies should be marked with their sizes before hardening.

"Slip" Flywheel and Gear Will Prevent Tool Breakage

COSTLY repairs and lost time can sometimes be prevented by fitting a production machine with a slip drive along the lines illustrated.

Hundreds of dollars were saved by such a revision in design of an automatic machine similar to a press, which had a heavy flywheel keyed to the drive shaft. Whenever the work caught or a foreign body dropped into the tools, the expensive set of tools was ruined and the machine placed on the idle list. These breakdowns have been



eliminated and all later machines have been similarly equipped.

The driving flywheel in this case had a good-sized hub that was faced off on both sides. A cast-iron stop plate, to which was riveted a $\frac{1}{4}$ -in. leather disk, was mounted on the inner side of the wheel and held in place on the shaft by a key and setscrew. A leather-faced steel disk was floated on the shaft on the outer side of the wheel hub as shown. This disk was forced against the hub by a large spring washer formed from $\frac{1}{8}$ -in. steel and tempered. To improve the springing qualities of this dish-shaped disk, four slots were made in it. A large nut on the end of the shaft was brought to bear against the spring disk.

The grip tension can be adjusted so that the flywheel will carry the load, but will slip when a blank or other object gets caught and binds the tools. In other words, the flywheel "gives" instead of the tools, which means longer tool life.

The illustration shows a "slip" gear mounting that is practically the same arrangement as the flywheel mounting described, except that a heavy coiled spring takes the place of the dish-shaped spring disk.—C. M. WILCOX.

\$50-\$300 a Week

You, too, can make this by learning the highest paid work in the whole motor car industry—Auto Painting. Over 2,000,000 new cars each year—13,000,000 cars in use need repainting in 12 months. Only trained men can do this. Factories, dealers, custom shops, all bidding for men. Demand exceeds supply everywhere.

We Fit You for Big Pay in Few Weeks

This thoroughly equipped school—approved by big auto plants—teaches you in 8 to 12 weeks. Personal instruction by experienced, practical auto painters. Every branch covered. You can hold high-pay job or run your own shop—be the head of big business.

GET FACTS TODAY

Write us today for facts about this wonderful trade and our methods. Don't delay! This is the greatest opportunity in any industry. Write today for details—then you be the judge.

DETROIT AUTO PAINTING SCHOOL
1409 Van Dyke Avenue Detroit, Mich.

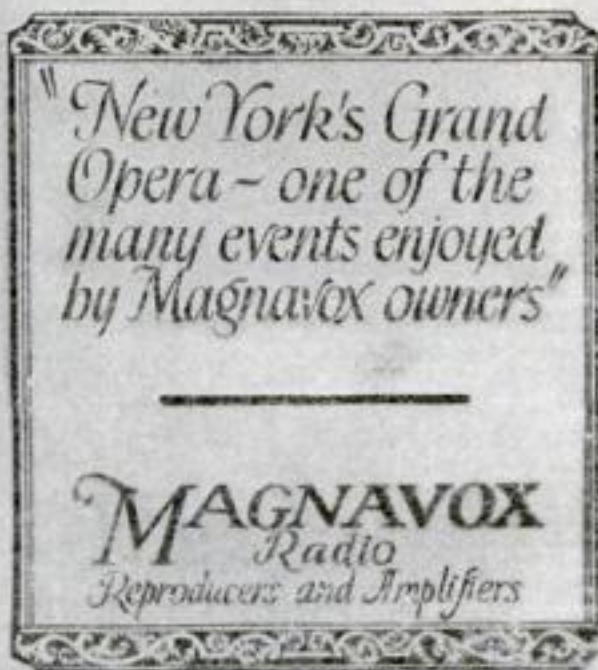
CATALOG E19-100 PAGES FREE

EVERYTHING IN RADIO
One of the largest complete stocks in the world. 40 diagrams of latest Hookups.
DEALERS ALL OVER THE U.S.

Making big profits handling our supplies. 24-hour service. Goods shipped same day order received.



WHOLESALE RADIO DISTRIBUTORS
Dept. B 6 W. 14th St. Kansas City, Mo.



MAGNAVOX instruments are never subject to those internal interferences which, at critical moments, are so apt to mar the performance of ordinary radio reproducers.

To measure the success which Magnavox engineers have accomplished in the design and manufacture of Magnavox products, remember that they have been sold in far larger quantities than any other radio units in the world.

Magnavox Reproducers

R2 with 18-inch curvex horn \$60.00
R3 with 14-inch curvex horn \$35.00
M1 with 14-inch curvex horn.
Requires no battery for the field.
\$35.00

horn and 1 stage of amplification
\$59.00

A2-R consisting of electro-dynamic
Reproducer with 14-inch curvex
horn and 2 stages of amplification
\$85.00

Magnavox Combination Sets

A1-R consisting of electro-dynamic
Reproducer with 14-inch curvex

Magnavox Power Amplifiers

A1-1-stage \$27.50
AC-2-C-2-stage \$55.00
AC-3-C-3-stage \$75.00

Magnavox Products are for sale at Registered Magnavox Dealers everywhere. Write for new 32-page Magnavox Radio Catalogue.

THE MAGNAVOX CO., Oakland, Calif.

New York Office: 370 Seventh Avenue

Perkins Electric Limited, Toronto, Montreal, Winnipeg, Canadian Distributors

2R

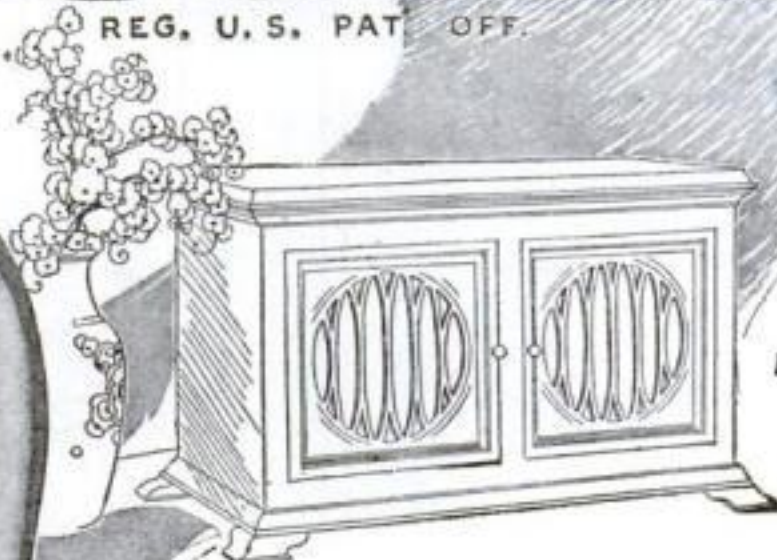
*For every
receiving set
there is a /
MAGNAVOX*

Radiotron

REG. U. S. PAT. OFF.



Radiotron WD-11
Radiotron WD-12
Radiotron UV-199
Radiotron UV-200
Radiotron UV-201-A



Radiola IV

In high quality receiving sets, the vacuum tubes — the heart of their fine performance — bear the name **Radiotron** and the **RCA** mark. Be sure to look for this identification when you replace your tubes.



This symbol
of quality
is your
protection



Radiola Grand

Send for the free booklet that describes
all Radiotrons and Radiolas.

Radio Corporation of America

Sales Offices:

233 Broadway, New York 10 So. La Salle St., Chicago, Ill. 433 California St., San Francisco, Cal.

RADIO CORPORATION OF AMERICA
Dept. 112 (Address office nearest you.)
Please send me your free Radio Booklet.

Name

Street Address

City R.F.D.

State

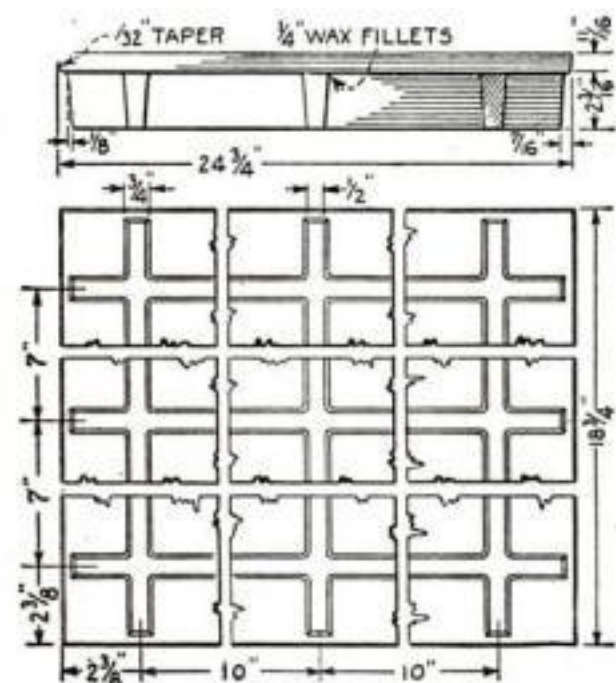
Radiola

REG. U. S. PAT. OFF.

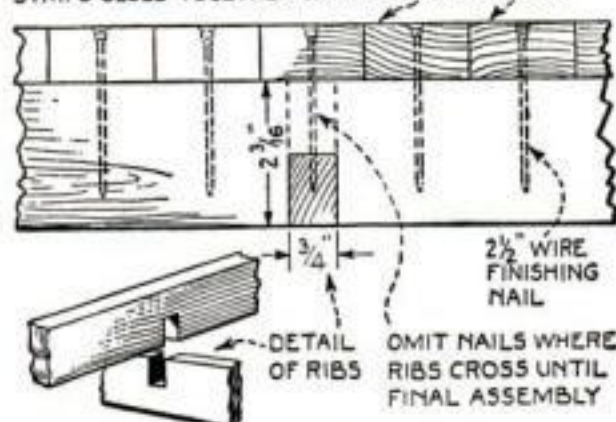
How to Make a Set of Accurate Cast-Iron Surface Plates

By Henry S. Laraby

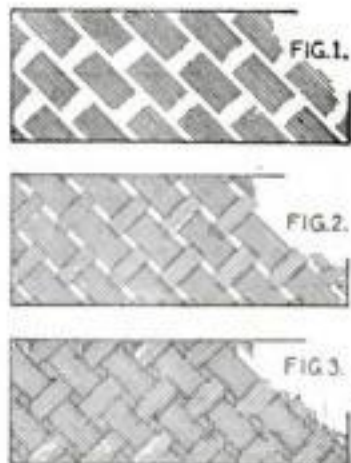
A PRECISION surface plate is a luxury seldom found in the small shop. This is, of course, due to its high cost and to the notion that accurate surfaces are difficult to produce. For years I too, labored under this impression, but finally decided to put my odd moments to better use by making a set of three. Once the pattern is completed and the castings are



STRIPS GLUED TOGETHER WITH GRAINS REVERSED



A condensed assembly view of details of an 18 by 24 in. surface plate is shown above. Allowance has been made in the dimensions for the shrinkage of the castings. At the right are shown the three steps in scraping the plate to a true surface



made from it, the plate can be left for those hours when work is slack.

The pattern is made of white pine. Ten strips 25 in. long are planed accurately to a size of $1 \frac{9}{16}$ by $1 \frac{15}{16}$ in. Two other strips $1 \frac{3}{4}$ by $1 \frac{15}{16}$ by 25 in. are made to serve as side strips, being slightly wider so as to allow for truing up the top when completed. These are now laid side by side with the grain running in the same direction lengthwise so that the top can be planed properly. Also, the end grain should be reversed on every other strip to prevent warping of the whole when glued together. The strips are then glued together and allowed to harden. The top next is planed on one side.

(Continued on page 106)

In Every Corner of the Earth

Science is Watching and Working to Disclose the Secrets of Nature

Out on the deserts of Egypt and in the dense jungles of the tropics—high up in the mountain observatory and down on the deep sea bottom—amid the perils of Arctic exploration and in the quiet of the

laboratory—everywhere science carries on its quest for the key to Nature's mysteries. And out of these great adventures has come the most thrilling romance in the world—the story of man's conquest of the Universe through his amazing scientific achievements.

At last this romance is yours—told for the first time in one flowing story that throws open to you the whole wonder world of science.

A Striking Book Free for You

That tells the Whole Amazing Story of—
The Outline of Science

Because every man, woman, and child in America ought to know about this epoch-making work, the publishers have prepared, for free distribution, a most interesting and strikingly illustrated brochure that tells the wonderful story of *The Outline of Science*. With four plates in full color and over thirty half-tone pictures of scientific marvels it shows how this splendid work tells of all the miracles of science since the beginning of time—how it reveals for you The Romance of the Heavens; Man's Rise From His Earliest Ancestry; Marvels of Insect, Plant, Animal, and Bird Life; Miracles of Electricity, of Chemistry, of Aviation, and a thousand more things of absorbing interest. Here, indeed, is the most amazing story ever written—the cream of the world's scientific genius. Don't fail to get your copy of this splendid booklet with its remarkable story and fascinating pictures. It entails no cost or obligation on you whatever. The coupon brings it immediately. Mail it now.

G. P. PUTNAM'S SONS

Dept. 138 2 West 45th Street New York

This Coupon Brings Your Copy

G. P. PUTNAM'S SONS, Dept. 138,
2 West 45th Street, New York.

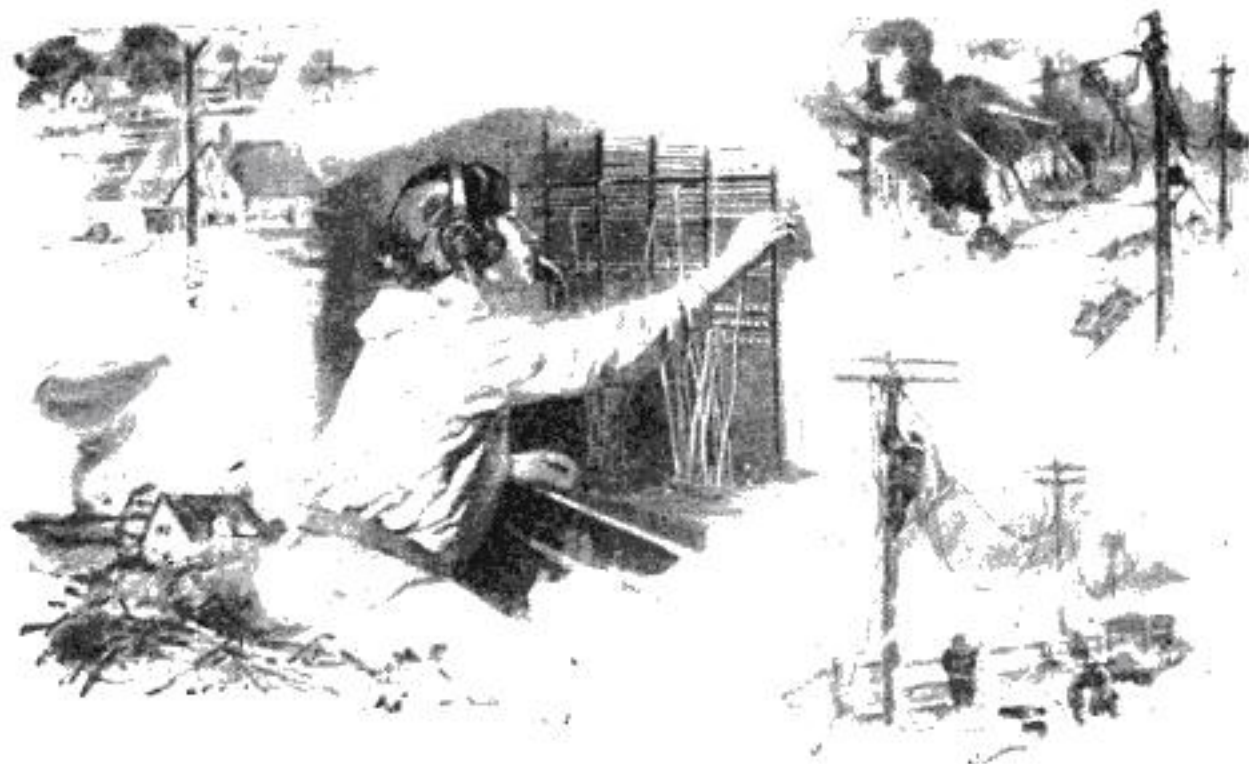
Send me by mail, without cost or obligation on my part, the free booklet with four color plates and over thirty half-tone illustrations describing *The Outline of Science*.

Name.....

Street and No.

City and State

Occupation



Priceless Service

Despite fire or storm or flood, a telephone operator sticks to her switchboard. A lineman risks life and limb that his wires may continue to vibrate with messages of business or social life. Other telephone employees forego comfort and even sacrifice health that the job may not be slighted.

True, the opportunity for these extremes of service has come to comparatively few; but they indicate the devotion to duty that prevails among the quarter-million telephone workers.

The mass of people called the public has come to take this type of service for granted and use the telephone in its daily business and in emergencies, seldom realizing what it receives in human devotion to duty, and what vast resources are drawn upon to restore service.

It is right that the public should receive this type of telephone service, that it should expect the employment of every practical improvement in the art, and should insist upon progress that keeps ahead of demand. Telephone users realize that dollars can never measure the value of many of their telephone calls. The public wants the service and, if it stops to think, cheerfully pays the moderate cost.



**AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM**

One Policy, One System, Universal Service

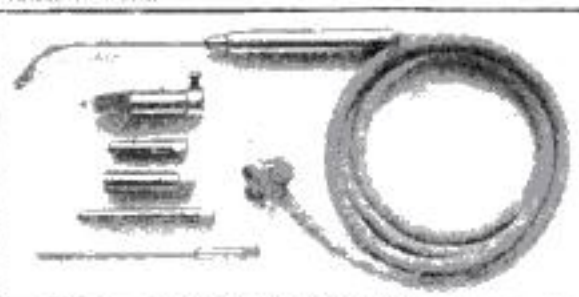


**Get
Factory
Prices**

**Write for Free
Bargain Catalog**
Someone orders
your range from the
factory regardless of
where you buy. Why not get
factory prices yourself and
save money? It is easy to deal
with Kalamazoo—simply write a
letter—get quick, safe delivery.
Long free trial. Less than \$15 down
brings any Kalamazoo range on easy pay-
ment plan. 200 or more styles and sizes—
porcelain enamel, steel, cast iron, malleable
construction. Furnaces, too, for any size home.
Special offer for limited time only. Write today.
KALAMAZOO STOVE COMPANY
782 Rochester Avenue Kalamazoo, Michigan

**ADD \$5.00 a DAY to YOUR PROFITS with a
TORIT ACETYLENE TORCH No. 13**

For radiator repairing, general soldering, light brazing, heating, battery repairing, etc. Produces instant hot flame, works rapidly. Furnished with 4 different tips and soldering copper, enabling you to do a wider range of work.



USES ACETYLENE ONLY

A splendid use for discarded auto acetylene tanks. Many owners make the Torit No. 13 pay for itself in a single day. Torch with 4 different tips, soldering copper, 5 ft. tubing and connection for auto acetylene tank \$7.50.
Order today from your jobber, or
St. Paul Welding & Mfg. Co., 164 W. 3rd St., St. Paul, Minn.

How to Make Surface Plates

(Continued from page 105)

The ribs also are made of white pine, three being $2\frac{3}{16}$ by $\frac{3}{4}$ by $17\frac{1}{8}$ in., and three, $2\frac{3}{16}$ by $\frac{3}{4}$ by $20\frac{1}{8}$ in. These are planed down to the dimensions shown on the drawing of the finished plate, and notched half way.

The ribs are then glued and nailed to the smooth side of the top and the other side is planed, the sides are squared, and a taper is made on the edges all around the top. The dimensions of the top now will be sufficiently large to allow for shrinkage.

Next, smooth off the bottom edges of the ribs, sandpaper the pattern and shellac over all. After a day, put $\frac{1}{4}$ -in. fillets of wax around the rib bases and give two more coats of shellac.

Finishing the Iron Castings

The pattern is now ready for the foundry, where three castings of gray cast iron should be made. These should be given distinctive markings before any work on them is done.

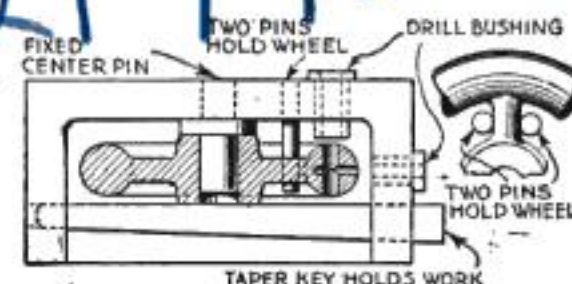
First the plates should be planed as accurately as possible. Then castings Nos. 1 and 2 are trued up by means of a straight edge and scraper. One of them is coated with Prussian blue or red lead and the two are rubbed together. In this way the high spots can be located and removed with a scraper.

Leaving No. 1 aside for the moment, repeat the operation with 2 and 3, but do not scrape 2 at all. By comparing 3 with 1 any errors are detected and an amount equal to half the error is scraped off each. Continuing in this way, rescrrape 1 and 2, then 3 and 2, finally checking with 1 and 3. This is continued until all three check.

How the scraping should be done is indicated in Figs. 1, 2 and 3, on page 105. By this method a careful workman can make three very accurate plates in his leisure moments.

Jig for Drilling Handwheels

THE simple jig illustrated is for holding a handwheel while drilling holes in the rim. The taper key is removed and the wheel is placed on the center pin. Two



Three pins locate the handwheel accurately and a taper key holds it in place

pins then are placed in seats in the jig to hold the wheel by bearing against one of the spokes and the key is driven in, thus locking the wheel. Two drill bushings guide the drills.—J. H. MOORE.

A HARD silver solder of low fusing point that is used extensively by one of the largest electrical companies is composed of 34.36 per cent copper, 49.24 per cent silver, and 16.4 per cent zinc. Borax is used as a flux.

A Perfect Glareless Headlight At Last



Distributors—Agents and Dealers—Can Make \$3,000 to \$15,000 or More a Year

The Detroit Safety Headlight Devices absolutely solve the greatest menace to auto-mobiling—the headlight glare. This is a new, simple device and fits any model of any car. Installed easily and quickly by anyone. Used with low priced plain glass lens. It

adds style and dignity to any car. It absolutely concentrates the light down on the road, not up in others' eyes. Drive with all the courtesy of the road with bright lights on. The glare is positively eliminated. Will last a lifetime. Will not rust, corrode or deteriorate. Meets every legal requirement. They are the best headlight devices made and stand any test.



Detroit Safety Headlight Devices Sell On Sight

They sell on sight—a demonstration sells anyone. Easily demonstrated in store, home or on car. Sold on 30 day trial—never taken out. Appeals to fairness—no one wants to drive others to death in ditch. Owners urge others to buy. See illustrations as to installation and effect.

Exclusive Territory—Newspaper Advertising—Installed Free

Exclusive territory granted to right men—we run newspaper advertising and arrange for **Free** installation by competent garages. Printed matter and cards also furnished. We want men in every county who can handle men and sales and make from

\$3,000 to \$15,000 or more according to territory.

We have a special Bonus Offer of Syndicate Shares to those who take territory at once. This offer cancels itself when 100,000 fully participating shares are allotted.

FREE—One Set. Free Introductory Advertising Offer

One set of Detroit Safety Headlight Devices in a neighborhood makes everyone want them. It's the best kind of advertising for our representatives. Therefore, for a short time we will sell two sets for the price of one (\$2.00) or one set at wholesale price of \$1.00, postage paid. Buy two sets, sell one easily at \$2.00—yours will be free. This offer is open to everyone to advertise the devices. When territory Representatives are appointed offer ceases—so act now. Easily installed by anyone. Get literature—clip **FREE** coupon, fill in, pin \$1 or \$2 bills to coupon—act quickly **NOW**.

Motor City Syndicate

Offices: 1217 Book Bldg., Dept. 42

Detroit, Mich., U. S. A.

FREE—One Set Free Coupon

Motor City Syndicate
Offices: 1217 Book Bldg., Dept. 42
Detroit, Mich.

Gentlemen: Without obligations, please send literature of Detroit Safety Headlight Devices. Send such offer as I have marked below.

Do you want to sell?.....

What territory?.....

Make of your car.....Model.....Year....

Make of other car.....Model.....Year....

Fill in both for \$2.00 offer.

Are you interested in Bonus Offer?.....

Just use Dollar Bills if sending money.

Enclosed \$..... for offer as marked above. These to be mailed postage paid.

Name.....

Address.....

City.....Stat.....

brass together and drilling a 3/16-in. hole for the crankpin. These brasses are held in place by the connecting-rod straps.

The crankcase of the engine is made from a piece of 1½-in. extra-heavy pipe 2 1/16 in. long. A ½ to 1¼ in. bushing is used as a connection between the center body of the engine and the crankcase.

One end of the 1½-in. pipe is tapped for the 1¼-in. bushing, while a standard thread is used for a square 1½-in. floor flange for the base. The four holes in the flange are used for connecting the whole with the wooden base.

The 1½-in. pipe is drilled and tapped 15/16 in. from bottom to center of holes for 3/8-in. pipe plugs. These plugs act as bearings for the crankshaft. Again care must be taken to drill these two holes in line with each other, as it would cause considerable difficulty if these two bearings were out of alinement.

Each of the 3/8-in. pipe plugs has a ¼-in. hole drilled through for the crankshaft, and 1/8-in. holes are drilled through the side of the plugs to act as oil holes. It is advisable to file both ends of plugs smooth and parallel with each other and, necessarily, at right angles to the shaft hole.

Crankshaft and Eccentric

The crankshaft is built of ¼-in. cold rolled stock and two disks 1 5/16 in. in diameter by 3/16 in. thick. A 3/16-in. pin is riveted between these two disks. The eccentric is fastened to one of them with the high side opposite the crankpin.

The eccentric moves the valve rod up and down through a small shoe, which is allowed to ride on the face of the eccentric and is held there by a small compression spring. The 1/8-in. valve rod is bent to the proper angle so as to line up with both holes and is threaded at both ends.

While not hard to make, the steam chest has the most work connected with it. The piece next to the cylinder and having the ports is made of brass, filed on one side to fit the side of the cylinder. For the top and bottom ports two 1/16-in. holes are drilled, as shown in the sectional view. The exhaust port is a 3/16-in. hole in the center of the block, and central between the upper and lower steam ports.

At least 1/8 in. of metal is to be left between the steam and exhaust ports. This distance governs the stroke length of the valve rod.

The center section of the steam chest is a hollowed out piece of brass of a size to suit the cylinder section. A hole is tapped on the upper side for a 1/8-in. steam pipe. The lower side is drilled 1/8 in. for the valve rod and drilled and tapped for the valve rod stuffing box.

The flywheel is 3 or 3½ in. in diameter. The wheel from an old valve can be used for this purpose. The pulley can be either grooved or plain, about 1 in. in diameter.

When assembled and adjusted, this model is a husky 5/8 by 1/8 in. steam engine and, for its efficiency and completeness, perhaps the cheapest small engine that can be built.

How to make an especially fine table for playing the fascinating Chinese games now so popular will be told in next month's Home Workshop.



No. 2692 Eveready two-cell aluminum flashlight complete with battery 75c—anywhere in the U. S. A.



To locate the trouble —use your flashlight!

LIGHTS out—something wrong! Use your flashlight to locate the trouble. Keep an Eveready at the top of the cellar stairs. Tie a tape around it and hang where it will be instantly convenient. Use it for safe steps in the emergency and all the time. No fire hazard. Don't fumble—keep an Eveready Flashlight in your room. Another in your garage for looking over the car at night—and use on the road.

Keep all your flashlights loaded with Eveready Unit Cells and you will have plenty of bright, white light when and where you need it.

If you have a flashlight not in use, get it out and reload with Eveready Unit Cells; long-lived cartridges of brilliant light. Buy them from any electrical or hardware dealer, drug, sporting goods or general store, garage or auto accessory shop.

When you buy new flashlights, be sure they have EVEREADY stamped on the end. EVEREADY means the highest standard of flashlight quality, and Eveready Unit Cells give more light longer.

Prices from 65c to \$4.50 complete with battery—anywhere in the U. S. A.

NATIONAL CARBON COMPANY, INC., New York, San Francisco
Canadian National Carbon Co., Limited. Factory and Offices: Toronto, Ont.

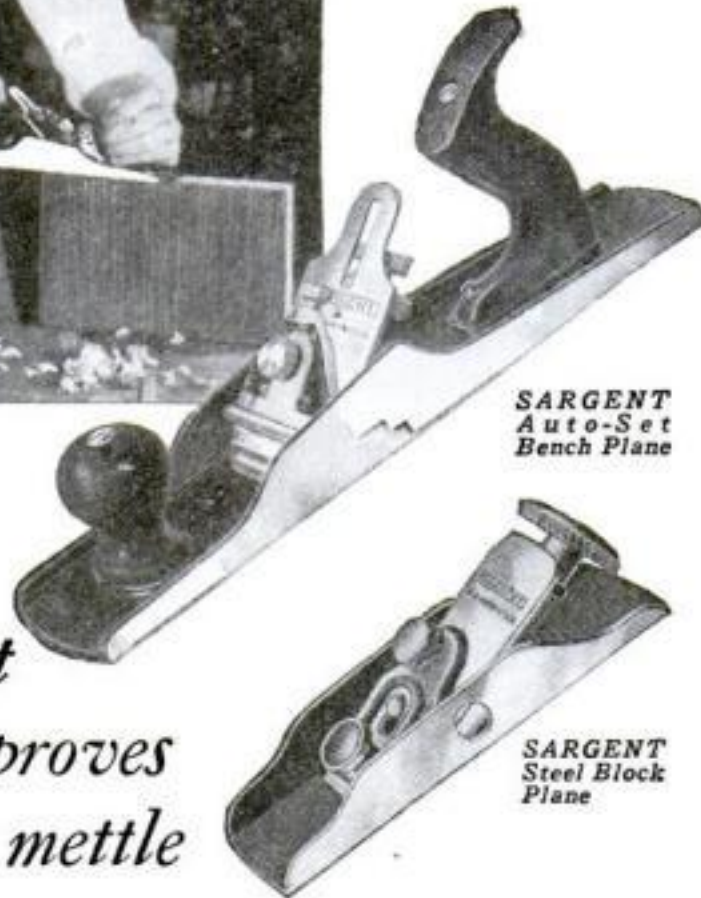
EVEREADY
FLASHLIGHTS
& BATTERIES
—they last longer

EVEREADY UNIT CELLS make all flashlights better.

Eveready Unit Cells fit and improve all makes of flashlights. Eveready Unit Cells come in two sizes to fit every tubular case flashlight.

Know the Eveready size that fits your case. Then you can buy new Eveready Unit Cells without bothering to take your flashlight along.

Eveready Unit Cells mean brighter flashlights and longer battery life.



The cross-grain cut is the test that proves this plane's mettle

THE Sargent Auto-Set Bench Plane has a reputation for coming through the thousand odd jobs that develop at a busy work bench, without a murmur or a moment's hesitation.

Its unusual cutting keenness—across or against as well as with the grain—will surprise you. Its all around dependability and simplicity of adjustment have gained for it, everywhere, that real affection which craftsmen feel toward tools which never fail them.

The auto-set feature permits the removal, whetting and replacement of the chromium steel cutter in the shortest possible time. Furthermore, in doing this it is not necessary to change the original adjustments.

Ask your hardware dealer to show you the Sargent Auto-Set and the Sargent Steel Block Plane for smaller jobs. You'll find they are made of lasting materials, perfectly fashioned and finely finished. Both are worth having.

Drop us a post card for the Sargent Book of Planes, which contains detailed information concerning them.

SARGENT & COMPANY, Hardware Manufacturers
50 Water Street, New Haven, Conn.

SARGENT

Tools & Hardware



A Gerstner CHEST

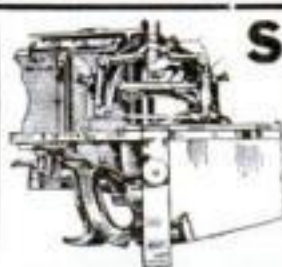
is valuable to
**MACHINISTS and
TOOLMAKERS**

Saves its cost many times in value of tools it saves from loss and damage. Write for free catalog.

H. GERSTNER & SONS
502 Columbia St., Dayton, O.



The Midget
"Five-in-One" Slide Rule
is a combination Mannheim, Poly-
metric, Log-Log, Binary, Add and Sub-
tract Slide Rule. It will instantly add,
subtract, multiply and divide any com-
bination of whole numbers, fractions,
mixed numbers and decimals. Gives
every root and power, also Logs, Sines
and Tangents. Made of aluminum with
scales on white celluloid. Size 4 in.
Approved and adopted by colleges.
Price with instructions, \$1.50. Leather
Case 50c extra. Catalogue Free.
Gilson Slide Rule Co., Niles, Mich.



Saw Filing Pays

Buy a Foley Saw Filer and
Setter and establish an in-
dependent, profitable business.
Write today for FREE Catalog.
Territory open to interested
parties.

FOLEY SAW-TOOL CO.
3613 Portland Avenue
MINNEAPOLIS, MINN.



"WONDER" COLD PIPE, TUBING & BAR BENDERS

Standard of the World.
HAND and MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our
way. Per bend.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
8" pipe \$1.00
Send for Catalogue.

AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. One Year to Pay. Boston, Mass.

Making the Loudspeaker Talk Up with Two-Stage Amplifier

(Continued from page 84)

wire to connect terminal F_1 of socket K with the wire just mentioned.

One terminal of condenser D is connected with the wire connected with post A and the other terminal of the condenser connected with the wire connected with post O .

A wire is next used to connect post P with the No. 2 terminal of rheostat H and the No. 1 terminal of rheostat I .

The No. 1 terminal of rheostat H is then connected with the F_2 terminal of socket F , while the No. 2 terminal of rheostat I is connected with the F_2 terminal of socket K .

The G terminal of transformer C is then connected with the G terminal of socket F , while the F terminal of the transformer is connected with binding post Q .

Next connect the top outside spring of jack G with the P terminal of socket F ; the inside spring, which makes contact with this outside spring, with the P terminal of transformer J ; the bottom outside spring with binding post R ; and the inside spring, which makes contact with the bottom spring, with the B terminal of the transformer.

Final Connections and Batteries

Now connect the G terminal of transformer J with the G terminal of socket K . The F terminal of the transformer is then connected with post S .

The P terminal of socket K is connected with the top outside spring of jack L . The inside spring, which makes contact with the top spring, is connected with binding post M .

The bottom outside spring of the jack is connected with binding post T , while the inside spring, which makes contact with the bottom spring, is connected with binding post N .

The batteries are easily connected. The positive of the A and the positive of the C batteries are connected with binding post O . The negative of the A battery is connected with binding post P . Leads from binding posts R and T are tried on various taps of the B battery, varying from 45 to 90 volts, until best results are obtained. Leads from binding posts Q and S are tried on various negative taps of the C battery until the best values have been obtained.

Although good results can be obtained even though the values of C and B batteries are not absolutely correct, best results are obtained only when these values are just right.

It will pay in the long run to spend some time in trying various combinations until best results are obtained.

The A battery used will, of course, depend on the type of tubes used. The total value of the B battery used for both the detector and amplifier should not exceed 90 volts. The C battery should have a value of about 7 volts. The tapped portion of a small B battery will usually do very well.

The positive 22½-volt terminal is used as the positive terminal of the battery, while the taps are used as the negative taps.

Hurling Ice Comet Is Novel Sport for Skaters

WHEN this ice comet is swung on the end of a rope and released, it strikes the ice and scoots away in a straight line on two of the fins. It is intended to be aimed at a suitable target, such as a pumpkin. Over smooth ice it will travel several hundred feet at great speed.

Cut the hardwood spindle 7 in. long and $2\frac{1}{2}$ in. in diameter, and taper one end to



The completed ice comet (at left) and method of sawing the fins or runners from sheet steel (below)



a conical point, which can best be done on a lathe. Then grip the wood in a vise and make four saw cuts parallel with the axis $\frac{1}{2}$ in. deep and equally spaced. From 20-gage sheet steel, cut four fins, each $1\frac{1}{2}$ in. wide and 1 in. less in length than the spindle. The front ends are curved on a grinder. Then the long edges are chipped slightly with a chisel and driven into the slots. A large screw eye is turned in the back end for fastening the rope.

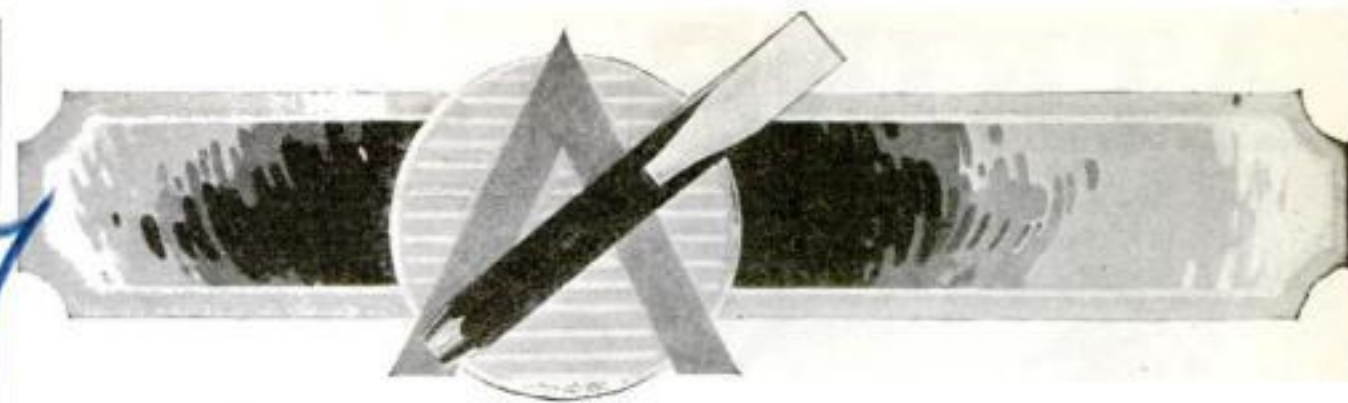
The wood should be protected from dampness by two coats of shellac, varnish, or paint.—D. V. H.

Dashboard Ammeter Is Useful for Testing Dry Cells

IF YOU have a car equipped with a dash ammeter, you can tell the exact amperage of a dry cell by attaching wires to it and holding their ends against the binding posts of the ammeter, as illustrated.

A cell that registers from 18 to 30 amperes is good. Cells that give only five or 10, while not good enough to connect with new cells, can be connected and used in an emergency. One dead cell, however, will reduce the current in the five good cells to next to nothing.

A VARNISH for wallpaper can be made of 1 part borax, 1 part flake white shellac, and 20 parts alcohol by weight, strained. Two coats will make the paper moderately washable.



Is There Such a Thing As a 100 Percent Perfect Chisel?

THERE IS. We can make 100 percent perfect chisels for cutting lead, concrete, nickel, steel, cast iron or anything else if we know in advance to what use the tool will be put.

To make an all-purpose Chisel, however, we must secure a perfect "average temper" at the cutting edge so that it will cut all materials exceptionally well, without dulling too quickly. This we have accomplished through the Vlchek Process of tempering Vanadium alloy steel of a special analysis.

The Chisel edge has extraordinary resistance. Vlchek tempering is neither too hard to

cause chipping or too soft to allow the edge to turn.

In Vlchek Chisels up to seven-sixteenth inch stock size we increase the size of the cutting edge by one-sixteenth of an inch, and in those from one-half inch to one inch stock, by one-eighth of an inch—added strength; greater cutting surface.

Vlchek Cold Chisels are splendidly proportioned. With relation to size of stock, cutting edge and length, they are in correct balance.

All Vlchek Tools are designed and made as carefully as our Cold Chisels, of the finest steel. They are tools of tremendous vitality, which means *long life*.

THE VLCHek TOOL COMPANY, CLEVELAND, OHIO

EASY TO SAY VELCHEK VLCHek TOOLS

MADE BY THE WORLD'S LARGEST PRODUCERS OF TOOL KITS

"Experiments With 110-Volt Alternating Current"

HERE at last is a book that gives a practical working knowledge of the alternating current.

The only way to gain a thorough understanding of electricity is by direct personal experiment. How a practical knowledge of the alternating current can be gained in an interesting and inexpensive way is shown. The knowledge that comes from experiment is of vastly more value than that acquired from the performance of the stereotyped series of battery experiments usually described in books on Alternating Current.

256 pages, 135 illustrations. Price, postpaid, \$1.75

POPULAR SCIENCE MONTHLY

225 West 39th Street

New York City

How To Make Things Electrical

Have the fun of doing it yourself and save half the cost

This book gives directions for making hundreds of electrical appliances and devices for the home, the shop and the garage. The simple directions and many drawings make the work easy.

429 pp. Price, \$1.50 postpaid

POPULAR SCIENCE MONTHLY

225 West 39th Street, New York City

ATKINS

METAL CUTTING SAWS



Use
Atkins
"Non-Breakable"
Hack Saw
Blades

"Best Blade I Ever Used"

That's what you'll say if you'll try an Atkins "Non-Breakable" Blade in your hack saw frame, next time you have a difficult job of metal cutting. With these blades you can cut faster and easier, and avoid blade breakage.

They are made of specially selected steel and tempered by an exclusive gas and oil process which gives them a harder, keener cutting edge and a tougher, more flexible back. That's the reason these blades have greater cutting capacity, hold their edge longer, and do not break. Prove it for yourself. Tell us what metal you cut, enclose ten cents and we'll send you a sample blade.

Saws of All Kinds

When you need a hand saw, circular saw, band saw, pruning saw, metal-cutting machine, or any saw for cutting wood or metal—there's an Atkins saw that will save time, money and labor. Write for our free booklets.



Send for This FREE Book

Helpful to Every Man Who Buys or Uses Saws

"Saws in the Shop" is a 32-page book that's full of practical suggestions on metal-cutting, and general shop information. Every man who buys or uses saws will find it helpful. Send for it NOW. Just write your name and address on the margin of this page and mail it to us.

E. C. ATKINS & CO., Inc.
Dept. D-20, INDIANAPOLIS, IND.
Makers of Silver Steel Saws and Tools

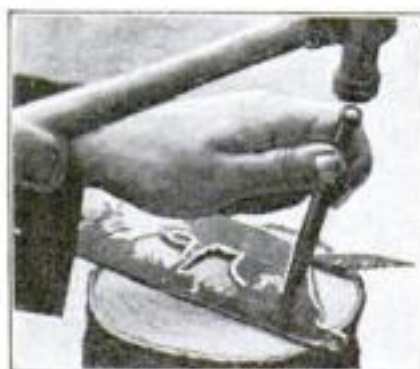
Decorative Weather-Vanes that Tell a Story

By Ernest Bade, Ph.D.

WEATHER-VANES may often tell a story in addition to the direction of the wind. For instance, a hunter might have a flock of geese flying over his house, a sailor, a metal ship upon a metal ocean,



After being cut out with a chisel, the ornamental vane is pivoted on an iron rod so that it will swing freely in the wind



a dog fancier, a dog pointing to the wind, or, as illustrated, a setter flushing a bird.

Such weather-vanes are easily made from thin sheet tin, zinc, or iron. First draw the silhouette of the desired design upon paper and transfer it to the metal to be cut.

Etch it in the metal with any pointed instrument; then, with cold chisel and hammer, gradually cut out the design. Although this sounds like a slow process, the work is comparatively rapid.

Note that two flaps are bent backward at right angles to the design, one at the top and the other at the bottom. Two



Two designs suitable for weather-vanes over the home of an enthusiastic hunter

holes are drilled or punched in these so that the whole will pivot easily on a strong iron rod. The rod is fastened to the roof or some support exposed to the wind.

When the weather-vane has been mounted, it is advisable to clamp another piece of metal around the rod to represent an arrow and the letter N. This part

(Continued on page 113)

MAKE MORE MONEY!

**\$3,000
PROFIT IN
4 MONTHS!**

CRISPETTES



GEORGE ALEXANDER of Pennsylvania made \$3000.00 in 4 months making and selling CRISPETTES with this outfit. (Nov. 7th, 1923).

Jacob Gordon, New Jersey, (November 2nd, 1923), says: "Profits over \$4000.00 in 2 months!" Mesner of Baltimore \$250.00, in one day! M. L. Cronen, Ohio, (November 3rd, 1923), writes: "Doing big business—sold over 200,000 packages Crispettes last year". Mrs. Lane, Pittsburgh, says: "Sold 8,000 packages in ONE day".

We Start You In Business

Crispettes easy to make, easy to sell. We furnish everything—complete outfit, secret formulas, raw materials, full directions, wrappers, etc. No experience needed. Little capital starts you on road to wealth. Open a retail store of your own. Sell wholesale to groceries, drug stores, etc.

Build a Business of Your Own

Crispettes sell fast everywhere. Everybody likes them. They're a delicious confection. We'll tell you how to build a business of your own. Start now, in your town.

Profit \$1,000 a Month Easily Possible

Send for illustrated BOOK OF FACTS. Tells how many people in small towns and big cities are making big successes of Crispette Business. Shows how, when and where to start. Full of valuable information. It's FREE. Write now. Postal brings it.

LONG EAKINS COMPANY
247 HIGH STREET SPRINGFIELD, OHIO



Special 5 Size Tap and Die Set, Only \$3.00

DIRECT FROM THE FACTORY TO YOU!
Our No. 12 Automobile Set furnished in our highly finished chestnut box contains 5 each taps and dies (1-4, 5-16, 3-8, 1-16, and 1-2"), is the S. A. E. thread, 1 die stock, and one tap and reamer wrench.

Our No. 11 Set is the same as No. 12 except that the thread is U.S. Instead of S.A.E. You are purchasing a splendid set at a very low figure. Send us your order at once and be one of our many satisfied customers.

Let us also send you one of our circulars illustrating our full line of Handy Tools.

WORCESTER STEEL PRODUCTS CO.
Dept. M, 29 Union Street, Worcester, Mass., U. S. A.



We have a wonderful new copyrighted system of teaching music by mail. To first pupils in each locality we will give free a \$20 superb Violin, Tenor Banjo, Ukulele, Hawaiian-Guitar, Banjo, Mandolin, Banjo-Ukulele, Banjo-Mandolin, Cornet or Banjo-Guitar absolutely free. Also teach Piano and Organ. Very small charge for lessons only. Four lessons will teach you several pieces. Over 100,000 successful players. We guarantee success or no charge. Complete outfit free. Write today, Dept. 148. No obligation. Slingerland School of Music, 1815 Orchard St., Chicago, Ill.

BECOME AN EXPERT ACCOUNTANT

Executive Accountants command big salaries. Thousands of firms need them. Only 5,000 Certified Public Accountants in U. S. Many are earning \$5,000 to \$10,000 a year. We train you thoroughly by mail. Spare time for C. P. A. examinations or executive accounting positions. Knowledge of bookkeeping unnecessary to begin. The course is under the personal supervision of William A. Castenholz, A. M. C. P. A., former Comptroller and Instructor, University of Illinois. Also former Director of the Illinois Society of C. P. A.'s, and of the National Association of Cost Accountants. He is assisted by a large staff of C. P. A.'s, including members of the American Institute of Accountants. Low tuition fee—easy terms. Write now for information. LaSalle Extension University, Dept. 283-H, Chicago. The Largest Business Training Institution in the World.

Records Made to Be Beaten!

That's what production-records are mostly for—to step-ahead and improve on.

The records of Veeder Counters say "Come on!" to the machine operator. They impel him to score, and score higher!

It's the same when developing a machine: the best record to date becomes merely a record to beat—when your gains register on a

Veeder COUNTER

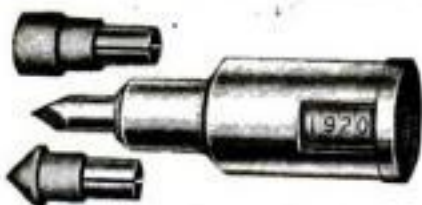
The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a reciprocating movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, \$11.50—subject to discount. (Cut less than 1/2 size.) Set-back Revolution Counter of similar model, \$10.00 (list).

Speed Counter

Here's the handiest instrument for finding revolutions-per-minute of a shaft or flywheel. You hold the tip of the counter against end of revolving shaft; press lightly when the second hand of your watch comes to 0; release pressure when minute is up. A spring clutch controls the recording mechanism.



(Cut less than 1/2 size.)

The Veeder Speed Counter enables you to keep motors, engines, generators, line shafting and machines operating at efficient speeds. Price, with two rubber tips (as illustrated) \$3.50.

FREE—The 80-page Veeder booklet of counters you'd like to see—and maybe apply.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

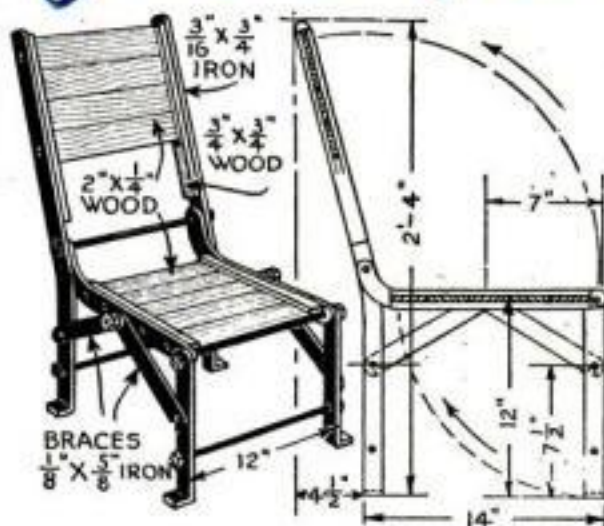
Making Decorative Vanes

(Continued from page 112)

need only be small, one eighth of the entire length of the vane being sufficient. It should be so attached to the rod that the arrow points toward the north.

Strong Folding Chair Made with Framework of Band Iron

ON AUTO and camping trips, I find useful the collapsible chair illustrated. Although it weighs only 5 lbs., it will sustain about 300 lbs. and is sturdy enough to stand the abuse that so often completely wrecks camping chairs. The



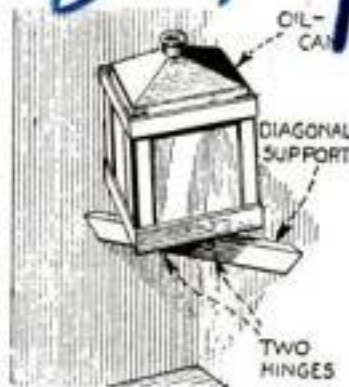
The completed chair and sectional view showing dimensions and method of folding

details of construction are made clear in the illustration.

The tie rods are 1/4 in. in diameter. The braces between the seat and the legs are pivoted to the seat frame by means of 1/4 by 3/4 in. cap screws, riveted for a loose fit. The back and seat are made of 1/4 by 2 in. slats fastened to 3/4-in. strips on each side. The arrows show how the seat folds.

Tilting Shelf for Oilcan

A CONVENIENT rack for oil can-tainers can be made by fastening the can crate on a diagonal piece in the corner of the garage, thus keeping it out of the way and facilitating pouring the oil.



To pour oil, the can is swung forward

yet allow it to be tipped forward with one hand, while the other holds the measure. If a crate is not available, one can be made to fit the can.

WHEN the pivot bolt of an iron pump or the pins of a door hinge become loose, it is advisable to try giving them a half turn. This will usually take out some, if not most, of the play.—L. M.



This handy vise, with swivel base, can be adjusted at any angle for any kind of work—"Bull Dog" Jaws—for 'all-around' use.

PRENTISS VISE

HERE'S just the tool you need for your work bench during winter months—a Prentiss Vise. All those little jobs you have been planning to do will be easier when you have this handy tool. Its strong jaws, deeply serrated, will hold objects of any shape, or size.

The jaw faces are interchangeable, and when worn may be renewed in a few moments.

The Prentiss Bull Dog Vise has swivel base, enabling you to turn your work at any angle—a great convenience for working in small space.

See a Prentiss Vise at your hardware dealer's on a display stand. If he doesn't have them in stock fill in the coupon and mail today.

PRENTISS VISE COMPANY
106-110 Lafayette St., New York City



Prentiss Patent Self Adjusting Jaw Vise, designed to hold pieces of any shape with slight pressure. The finest type of vise made. Steel jaw faces interchangeable.

Prentiss Vise Company
106-110 Lafayette St., New York City

Please tell me the name of the nearest dealer selling Prentiss Vises.

Name

Address

City



Now for the hook-up

THE radio set builder's eyes shine with pride as he inspects his drilled Celoron panel. He has done a good job. The finely finished Celoron panel reflects his good workmanship. He is ready to mount his instruments and make the final connections.

A Celoron panel insures good looks to the radio set. Celoron panels are finished in black, oak and mahogany. Each Celoron panel is wrapped in a dust-proof glassine envelope to protect its lustrous surface. Grit can not scratch it. Hands can not fingerprint it. You are the first to unwrap it.

Celoron, a bakelite product, has high dielectric strength. It is approved by the U. S. Navy Department Bureau of Engineering and the U. S. Signal Corps.

Special-sized Celoron panels are cut to order from sheet Celoron. Standard Celoron panels come cut and trimmed, ready to use, in these sizes:

1—6 x 7 x $\frac{1}{8}$	5—7 x 18 x $\frac{3}{16}$
2—7 x 9 x $\frac{1}{8}$	6—7 x 21 x $\frac{3}{16}$
3—7 x 12 x $\frac{1}{8}$	7—7 x 24 x $\frac{3}{16}$
4—7 x 14 x $\frac{3}{16}$	8—12 x 18 x $\frac{3}{16}$
9—7 x 26 x $\frac{3}{16}$	

Write for our interesting booklet, "Getting the Right Hook-Up." Sent free upon request.

To radio dealers: Send for special dealer price list showing standard assortments

Diamond State Fibre Company

BRIDGEPORT

(near Philadelphia)

PENNSYLVANIA

Offices in Principal Cities

In Canada: Diamond State Fibre Company of Canada, Limited, 245 Carlaw Avenue, Toronto

CONDENSITE
CELORON
STANDARD RADIO PANEL

The Wireless Experimenter's Manual

E. E. Bucher

THIS book thoroughly covers the entire field of amateur radio work, including the theory and design of amateur wireless transmitters and receivers, the construction of transformers, high voltage condensers, spark gaps, aerials, masts, and receiving sets for long and short wave receptions. 330 pp. Fully illustrated. Price \$2.25.

POPULAR SCIENCE MONTHLY
225 West 39th Street, New York City

Practical Amateur Wireless Stations

This book contains best suggestions of thirty-three experimenters on building, installing and operating experimental stations for radio communication.

Profusely illustrated. 137 pp.

PRICE 75c

POPULAR SCIENCE MONTHLY
225 West 39th St., New York City, N. Y.

Unique Plant Stand Has Trellis Support for Bird Cage

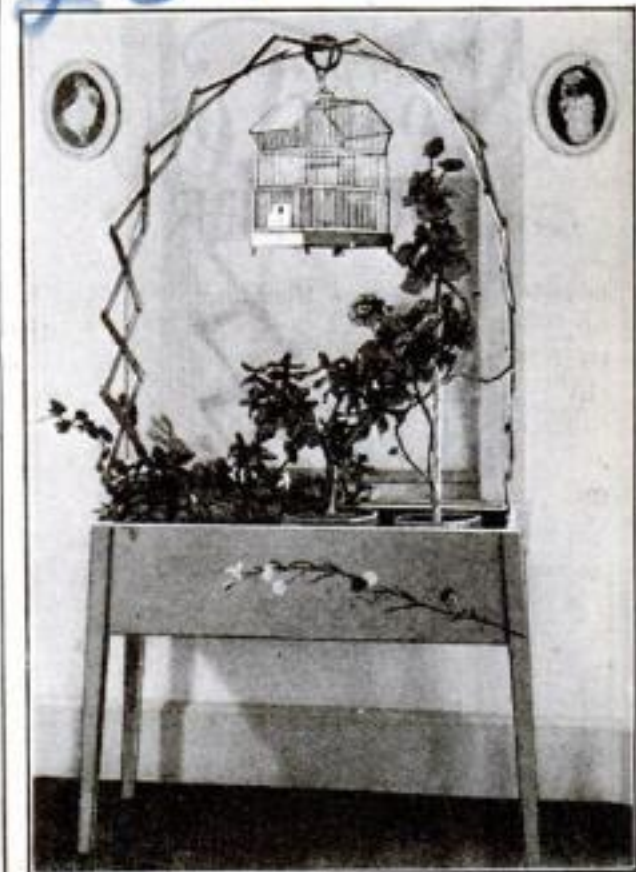
By Stacy E. Matthews

ONE of the pieces in a dining-room set I recently built for my home is the three-in-one plant stand illustrated. It is distinguished from the average flower box by the trellis work and hanging bird cage, and yet, with all its novelty, it is not difficult or expensive to construct.

The materials, which cost me about \$3, are as follows:

1 pc. $1\frac{1}{2}$ by 10 in. by 29 in. white pine, clear
1 pc. $\frac{3}{4}$ by $9\frac{1}{2}$ in. by 8 ft. white pine, seconds
1 pc. $\frac{3}{4}$ by 12 in. by 3 ft. 1 in. white pine, seconds
1 pc. $\frac{3}{4}$ in. by 10 ft. 2 in. band iron
47 lineal ft. $\frac{1}{2}$ by $\frac{3}{4}$ in. redwood strips
8 lineal ft. $\frac{1}{2}$ by $\frac{1}{2}$ in. strips, any wood
4 $\frac{1}{2}$ by $1\frac{1}{2}$ in. carriage bolts
20 $\frac{3}{16}$ by $\frac{3}{4}$ in. stove bolts
1 pt. paint any color desired

First rip the four posts $1\frac{1}{2}$ by $1\frac{1}{2}$ by 29 in. and dress them to $1\frac{1}{2}$ in. square.



Much as it differs from the conventional plant stand, this attractive piece of furniture is easily and cheaply made

Lay them off in pairs to be plowed— $\frac{1}{2}$ by $\frac{1}{2}$ in.—for the sides and ends. After plowing, taper the posts on the inside edges only from the bottom of the plowed groove to 1 by 1 in. square at the lower ends. Next, cut the two side panels, $9\frac{1}{2}$ in. wide, 36 in. long at the bottom, and 35 in. long at the top, and the two ends, which are $9\frac{1}{2}$ by 12 in. The bottom, $\frac{1}{8}$ by 12 by 36 in., must be cut out for the posts at each corner and fitted in from underneath. Then the $\frac{1}{2}$ by $\frac{1}{2}$ in. strips are fastened with finishing nails to hold up the bottom.

The foundation for the lattice-work is the strip of band iron. Beginning near each end, drill a series of $\frac{3}{16}$ in. equally spaced holes about 7 in. apart. Then after fastening one end in the box, gradually spring the other until it is arch shaped and bolt the second end in place. Next bolt a pair of $\frac{1}{8}$ by $\frac{1}{8}$ by 14 in. redwood, cedar, or cypress strips to each of the remaining holes in the band iron. The first pairs of strips will probably have to be specially fitted in the box. The outside ends of the strips are finally bolted together to form a diamond design. The

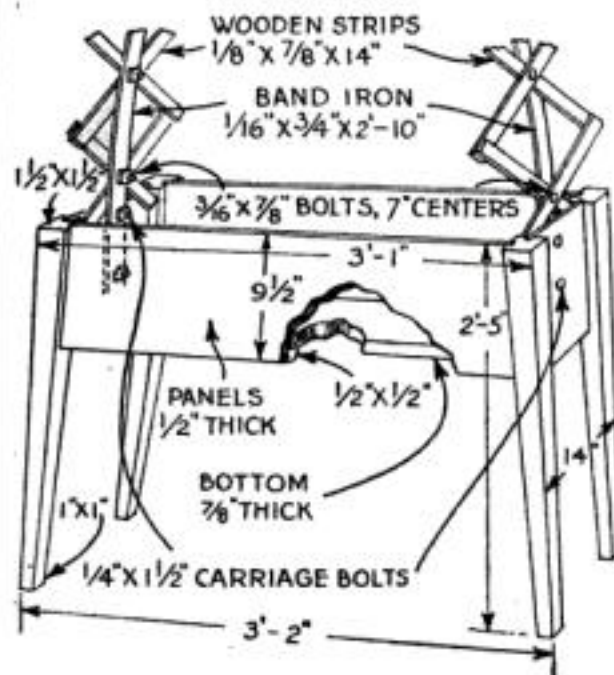
(Continued on page 115)

Unique Plant Stand

(Continued from page 114)

spring for the bird cage is fastened to the central point of the lattice-work.

Several coats of paint should be given and for best results the last coat should



Details and dimensions of the flower box and trellis, which cost about \$3

be well rubbed with pumice-stone and oil. The floral spray is a painted motive that appears on the buffet, serving-table, china closet, and tea wagon of the dining-room set. A central stenciled ornament and plain line border would perhaps be more effective for general use.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
225 West 39th St., New York

GENTLEMEN:

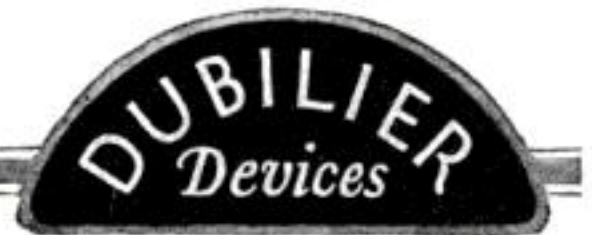
Send me the blueprint, or blueprints, I have checked below, for which I inclose.....cents in stamps or coin:

No.	Title	Price	
1.	Sewing Table.....	25c	<input type="checkbox"/>
2.	Smoking Cabinet.....	25c	<input type="checkbox"/>
3.	Book Trough End Table.....	25c	<input type="checkbox"/>
5.	Kitchen Cabinet.....	25c	<input type="checkbox"/>
6.	V. T. Radio Receiving Set.....	25c	<input type="checkbox"/>
8.	Shaving Cabinet.....	25c	<input type="checkbox"/>
9.	Arbor with Gate and Seats.....	25c	<input type="checkbox"/>
10.	Porch Swing.....	25c	<input type="checkbox"/>
11.	Bench and Tilt-Top Table.....	25c	<input type="checkbox"/>
12.	Electric Washing Machine.....	25c	<input type="checkbox"/>
13.	Tea Wagon.....	25c	<input type="checkbox"/>
14.	Toy Train, Horse, and House.....	25c	<input type="checkbox"/>
15.	Home Workshop Bench.....	25c	<input type="checkbox"/>
16.	Inlaid Radio Cabinet.....	25c	<input type="checkbox"/>
17.	Cedar and Mahogany Chest.....	25c	<input type="checkbox"/>
18.	Telephone Table and Stool.....	25c	<input type="checkbox"/>
19.	Grandfather's Clock.....	25c	<input type="checkbox"/>
20.	Flat Top Desk.....	25c	<input type="checkbox"/>
21.	Colonial Writing Desk.....	25c	<input type="checkbox"/>
22.	Girl's Cabinet and Desk.....	25c	<input type="checkbox"/>
23.	Pergola Garage.....	25c	<input type="checkbox"/>
24.	Gateleg Table.....	25c	<input type="checkbox"/>
25.	Sailing Outfit for Canoe.....	25c	<input type="checkbox"/>
26.	Baby's Crib and Play Pen.....	25c	<input type="checkbox"/>
27.	Kitchen Cabinet Work Table.....	25c	<input type="checkbox"/>
28.	Pullman Play Table.....	25c	<input type="checkbox"/>
29.	Toy Tea Cart, Garage, etc.....	25c	<input type="checkbox"/>
30.	Tool Cabinet, Bench Hook, etc.....	25c	<input type="checkbox"/>
31.	Priscilla Sewing Cabinets.....	25c	<input type="checkbox"/>

Name.....
(Please print)

Street.....

City and State.....

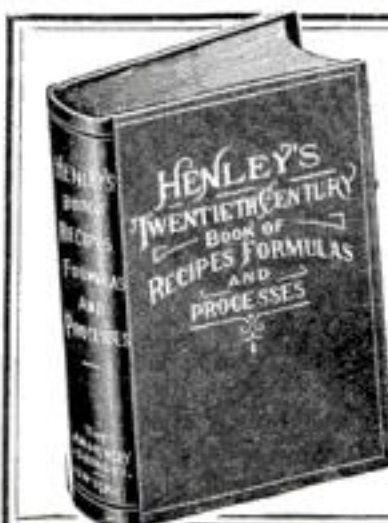


The Dubilier Ducon is the standard socket-plug.

It takes the place of the cumbrous, unsightly antenna.

Simply screw the Ducon in any lamp-socket and connect it with the radio set. Not only are the broadcasting stations heard clearly, but tuning is sharper.

Dubilier Condenser and Radio Corporation
48-50 West Fourth Street New York



TWENTIETH CENTURY Book of Recipes, Formulas and Processes

This book of 800 pages is the most complete Book of Recipes ever published. Hints, Helps, Practical Ideas and Secret Processes covering every branch of the useful arts are given.

A mine of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have that are not found in any other work.

Price, \$4.00

Popular Science Monthly, 225 W. 39th St., New York

CHEAP FUEL Burn Nu-Gas

In Your Present
Stove

No More
Coal Bills
— No Wood
Chopping —
No Dirt or
Drudgery

UP-TO-DATE homes are being built without coal bins. There's an easier, cleaner, better way to cook, heat and bake. A simple little device known as "NU-HEAT" that slips in a jiffy into any stove, heater or range, takes one part of coal oil (kerosene) and mixes it with twenty parts of free air. This makes "NU-GAS," a cheaper gas than city gas. Has twice the heat of coal.

Heat
Always
Ready—at
a twist of
the wrist



Slips into any heater or
range in a jiffy

A Warm House On Arising

Don't shiver on cold mornings while building a fire. All you do is turn a tap—you have intense, glowing cheerful heat almost instantly. Warms coldest rooms in few minutes. As much heat as you need on "blizzard" days, or just enough to be comfortable on milder days.



Better Cooking and Baking



Coal and wood heat are never steady. Oven temperature is constantly changing. That ruins many a baking. But the new method gives you steady, even, dependable heat ALL THE TIME. As much or as little as you need.

30 Days' Free Trial

Absolutely safe. And an ironclad guarantee insures that you'll be delighted with this freedom from coal drudgery—this clean, economical way to cook, heat and bake. And you may have one of these devices on 30 days' free trial.

Information Free!

Investigate this remarkable new way to save coal bills—get better baking results—cut housework in half, and have the warmest, cleanest, coziest home in town. Just say "send information free." Special introductory low price offer if you write at once. Mention if you have heater, range, furnace. Send coupon or postcard today.

Wade Hill Mfg. Company

Dept. B-41, St. Louis, Mo.

WADE HILL MFG. CO.

Dept. B-41, St. Louis, Mo.

Send me information showing how NU-HEAT operates and why it is the latest, best and cheapest of all gas-making devices. Explain Special Introductory Low Price Offer.

I have Heater () Range () Furnace ()

Name _____

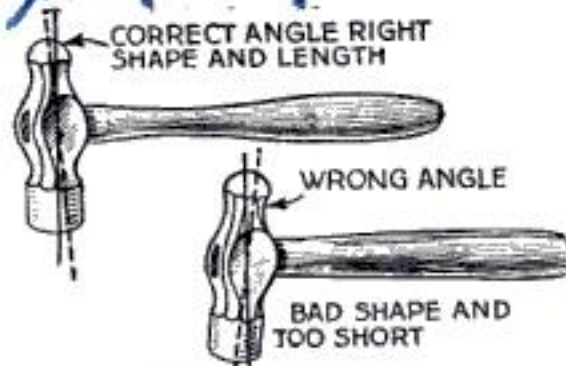
Address _____

City _____ State _____

A Golden Rule Insures Your Success with Tools

DO UNTO your tools as you would have done unto you, if you were a tool. This is the golden rule as applied to tools. It also can be applied with good effect in the Chinese or negative form, "do not unto others," and so on. Proper cleaning and lubrication, together with correct sharpening and repairing, always pay.

One of the most important tools used in the home or shop is the hammer. How



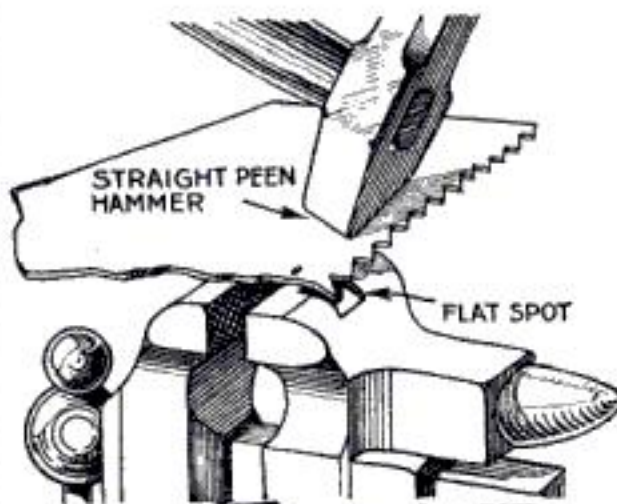
Handles must be fitted to hammer heads at a slight angle, as shown, somewhat exaggerated in the upper drawing

does our rule apply to the hammer? Well, use it as it should be used, always hitting with the head and never the side. Keep a good strong handle in the hammer, and never use a hammer with a cracked handle.

The handle should be of the proper shape and length. To have a hammer in perfect balance, insert the handle so that the central axis through the head stands at a slight angle to the vertical axis of the handle, with the driving head a trifle low. If a handle is inserted in a reverse fashion, with the head standing high, it will be awkward to use and handle. This is illustrated somewhat exaggeratedly for the sake of clearness.

If a hammer face chips, have it annealed slightly. A hammer that chips is dangerous to use, and if the chips are large and deep, discard the hammer altogether.

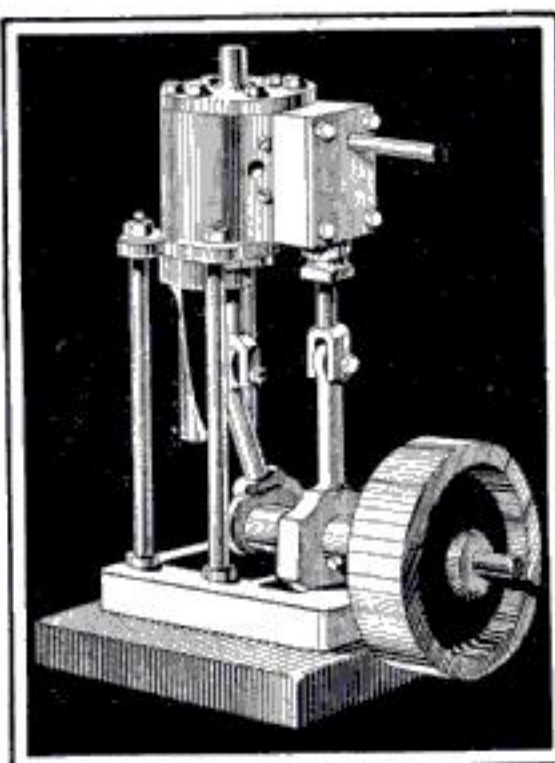
Many a weary back and arm can be spared if the saws are kept well set and sharp. Lack of a saw set is no excuse for not setting the teeth of an otherwise good



Using a flat spot on the rear vise jaw as an anvil for setting the teeth of a dull saw

saw, because the top of your vise will serve as a place to set your saw. On the rear jaw, where the straight, flat surface verges into the radius of the rear sloping surface, file a small flat, as illustrated. This flat should be at an angle of from 5 to 7 degrees. Lay the saw on the vise jaws

(Continued on page 117)



GET A HOBBY MAKE MODELS Start a Home Workshop

"Model Making," by R. F. Yates, describes the construction of gas-model engines, steam-engines, locomotives, boats, dynamos, turbines, railroads, guns, etc. Thirty chapters are devoted to models of various nature. It will help you to become a better mechanic. It will help you to do hard soldering, soft soldering, lathe work, tempering, drilling, pattern-making, etc.

This is a book every amateur or professional mechanic and model maker should have. "Model Making" describes real engineering models, not toys.

400 Pages, 300 Illustrations. Practical, complete, easily understood. Price, Post-paid, \$3.00.

Popular Science Monthly
225 West 39th Street New York

LOFTIS
BROS. & CO. EST'D 1858

Genuine DIAMONDS
Guaranteed

Cash or Credit

We import diamonds direct from Europe and sell direct by mail—a great saving to you. SEND FOR CATALOG. Everything fully explained. Over 2,000 illustrations. CREDIT TERMS on all articles: One-fifth down, balance divided into equal payments within eight months.

The Little Carved "Perfection" Diamond Ring illustrated in Solid 14-K Green Gold, Diamond set in White Gold, Bridal Blossom design. Wedding Rings to match.

Blue White, Brilliant, Perfect Cut Diamond. Marvellous Value at \$50, \$75, \$100, \$125 and up.

WRIST WATCH

18-K Solid White Gold, 17 Jewels, \$29.75
14-K Solid White Gold, 17 Jewels, \$24.85

LOFTIS BROS. & CO.
Dept. K 871
108 N. State Street, Chicago, Ill.

Only \$14.24

Down For 2 H.P. WITTE
(Throttling Governor)

Easy Terms on best engine built. Burns kerosene, distillate, gasoline or gas. Change power at will. Equipped with the famous WICO Magneto. Other sizes, 2 to 25 H.P.—all styles.

FREE—Write today for my Big Engine Book. Sent free—No obligation on your part.

WITTE ENGINE WORKS
2221 Oakland Avenue, - KANSAS CITY, MO.
2221 Empire Building, - PITTSBURGH, PA.

ARITHMETIC OF ELECTRICITY

A practical treatise on electrical calculations of all kinds reduced to a series of rules, all of the simplest forms, and involving only ordinary arithmetic. 200 pp. Price, \$1.50.

POPULAR SCIENCE MONTHLY
225 W. 39th St. :: :: NEW YORK

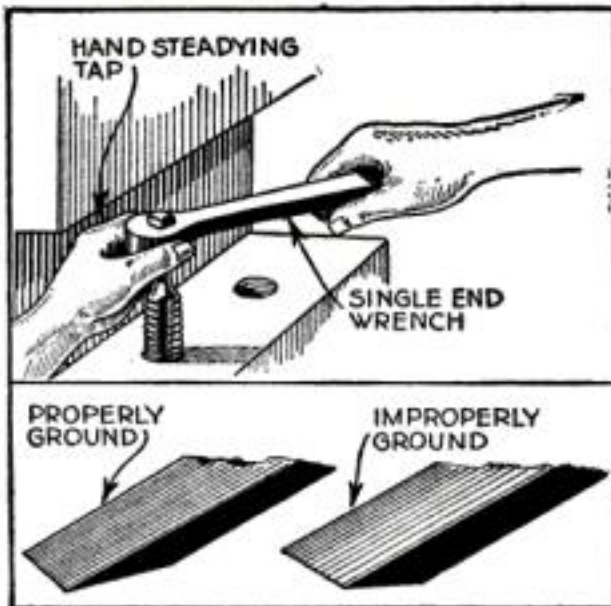
Golden Rule Insures Success

(Continued from page 116)

and with a straight peen hammer, peen each alternate tooth to the bevel of the filed spot. Turn the saw around and repeat the process on the remaining straight-teeth. If carried out carefully, this little trick will enable one to make a good job of setting saws, although it is easier for an amateur to use a regular saw set if one is available.

Before jamming your saw through an old piece of lumber, look the piece over to see whether there are any nails or screws hidden beneath the surface. If you do hit a nail, stop immediately, to save the saw teeth. Turn the piece around and saw the remaining distance nearly through from the other side.

Keep your plane irons sharp, and when grinding them do not try to hurry the job by robbing them of clearance. An iron to be ground properly must have a fairly



Using single-end wrench when tapping in a tight place and sharpening planes and chisels

long, thin edge. A hurried job will result in a blunt, thick edge, which will not cut freely. If a plane blade is nicked by coming in contact with metal, it will leave a raised line on the finished work, and therefore should be reground at once.

Chisels should be ground like plane irons. They should never be used to open tin boxes, scrape off paint, and other jobs that dull the cutting edge.

When a bit hits a nail or screw, one or more of its three main parts are affected: The lips are burred, the cutting edges dulled, or the center feed screw ruined. While it is possible at times to fix up a ruined bit with a file, it usually will not function as it should. Use caution and examine the wood carefully before sinking a bit into it.

When drilling the harder metals, such as steel and cast iron, stop immediately when the drill starts to squeak or smoke excessively. If one persists in forcing a smoking and squeaking drill through a hard piece of metal, the result will be a burnt-up drill.

At the first sign of a drill's becoming dull, remove and resharpen it; then reduce the speed of the drill press and jack up the feed. This is done to get under the glazed surface at the bottom of the drilled hole; that done, the remainder of the hole can be finished as usual.

When cutting scale either on cast iron
(Continued on page 118)

Only 50 days Between You and Big Money in AUTOMOTIVE ELECTRICITY



Four Times His Former Salary
"I was making \$40 a week as Head Bookkeeper when I took up your training. Last week I made \$175, and hardly a week passes in which I don't make at least \$100. No labor either. I locate the trouble and the mechanics do the work."
"HENRY L. LUDLOW, Indiana"



Makes \$1000 a Month
"I trained with you 7 weeks. Then I started right to work with a big garage. Averaged about \$150 a week. After 8 weeks I opened my own shop. Find it easy to get any price I choose to charge. Clearing over \$1000 a month."
"W. C. ELLERD, Neb."

**Come to Chicago
or Train at Home
for this New Field
that covers 78% of
AUTOMOBILE
TROUBLES**

YOU'D probably be willing to take a four year college course if you could earn \$132.00 a week when through. But you don't have to. **FOR YOU CAN BE READY IN FIFTY DAYS** to earn that much and more, just like any number of my former students are doing. Get my book that gives the facts and figures.

Big Jobs Open

This fascinating new profession is clamoring for men. Garage and Repair Shop Owners can get all the ordinary mechanics they need. Mechanics can learn in a shop, but Auto-Electrical Experts are study-trained. That's why shops can't get the man who knows automobile electricity. And yet they have to have him. Auto-owners will no longer pay for 10 hours' service while an ordinary mechanic fiddles around trying to find what is wrong. When you consider that 78% of all automobile troubles are electrical troubles you'll realize why the car owners are combing the market for experts. My free book will give you some surprising facts.

No Experience

Best of all, you can get in this big pay profession in 50 days—without knowing about electricity or automobiles beforehand. If you can read and write, you can succeed. We teach you everything in a practical, brass tacks way, which my book explains fully.

Amazing New Way to Train

When the government needed Auto-Electrical Experts for the war there was no time to waste. Men had to be trained 100% right and sent out almost overnight. The man who invented the 50-day method was the man to whom Uncle Sam went for help. Results were amazing. Never before had such a thing been accomplished by anyone. A complete, practical, thorough training in 50 days. So remarkable that after the war, and at a great cost, it was made available to Ambu students only.

Ambu has even improved on the original plan by not admitting more than 20 men to a class. No other school does this and the smaller the class the more you learn. When my graduates are grabbed up at big salaries; when men like Ludlow jump from a \$40 a week

bookkeeping job into an income of \$175 a week as Automotive Electrical Expert; when fellows who want to be their own boss, like Ellerd, clean up \$1000 a month; everybody simply HAS to agree that Ambu Training can't be beat. Get my book and see the proof.

Get Out of the Grease

I know what a demand there is for my graduates. I know what remarkable earnings they are making. I know how employers are glad to get their services. I have hundreds of letters that show how Ambu graduates "make good." I'll send you copies of them; tell you to write these former pupils, let them tell you what a fascinating, easy profession it is. In my free book I show you how you can get paid big for headwork, not handwork; how to get out of the grease, lifting, labor, etc., which the ordinary mechanic has to do.

Get FREE Book

Everything is explained in a remarkable eye-opening book that will be a revelation to you. It shows how my graduates are equally expert whether they come to classes here in Chicago

or LEARN IN SPARE TIME AT HOME. Get it at once. It is free. If you act quick you'll also be able to take advantage of a most unusual short-time offer I am making. Mail coupon today.

C. J. BUCKWALTER, Pres.

AMBU ENGINEERING INSTITUTE

Dept. 42
2632 Prairie Avenue
CHICAGO



C. J. Buckwalter, Pres.
AMBU ENGINEERING INSTITUTE
Dept. 42, 2632 Prairie Ave., Chicago
Please send me FREE book and complete information about the big-pay, uncrowded field of Automotive Electricity. Explain how your remarkable short time offer.
☐ Home Study Course
☐ Resident Course at Chicago.
Name..... Address..... City..... State.....

How to Get A Position with the U. S. Government

Thousands of appointments are made yearly. Good salaries—short hours—liberal vacations. Positions open now in Washington and other cities and in Alaska, Porto Rico, Hawaii and the Philippines.

Write to-day for 48-page FREE BOOKLET on CIVIL SERVICE, which tells you how you can get a good-paying position with the United States Government.

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7676-C, Scranton, Penna.

Deafness



Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums
"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable. Write today for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.
WILSON EAR DRUM CO., Incorporated
597 Inter-Southern Bldg. Louisville, Ky.

Coto

"Built First to Last"

Build your Radio Set Compact for

EFFICIENCY
ECONOMY
PORTABILITY

NOTE the small sizes of these remarkably efficient and far famed radio parts. Picture the individuality of a Coto Compact set. Insist that your dealer supply you. If he fails you, write us at once.



New Coto Compact Moulded Variometer

Size only $3\frac{1}{4} \times 1\frac{1}{4} \times 3\frac{1}{4}$ in. In moulded bakelite. Stator is honeycomb wound. Pigtail connection to rotor. Range 200 to 600 meters. Base or panel mount. Type 8000..... \$5



New Coto Compact Variocoupler

Companion piece of the Variometer. Size only $3\frac{1}{4} \times 3 \times 3\frac{1}{4}$ in. Range 200 to 600 meters. Base or panel mount. Pigtail connection to rotor. Type 9000..... \$5.50



New Coto Compact Air Condenser with Vernier

Only $2\frac{7}{8}$ inches square. Rotor Plates soldered to shaft. Stator plates soldered to supports.

.0005 Mfd. \$5 .001 Mfd. \$6

Other Coto specialties are Coto-grip Tube Sockets, Honeycomb Wound Coils, Tapped Radio Frequency Transformers, Audio Frequency Transformers.

Type 4,000 \$5 Type 4,500 \$2.50

COTO-COIL CO.

87 Willard Ave., Providence, R. I.

Branch Offices:

Los Angeles, 329 Union League Bldg.
Minneapolis, Geo. F. Darling, 765 Plymouth Bldg.
Atlanta, C. P. Atkinson, Atlanta Trust Co. Bldg.

Golden Rule Insures Success

(Continued from page 117)

or steel, always remember to use a slow speed and a heavy feed. Water makes an ideal lubricant for cast iron scale, while kerosene is used on steel castings.

When trying to tap a drilled hole in a cramped place, it is often necessary to use a single-end wrench. This invariably causes trouble, as the one-sided pull makes it hard to tap straight and the tap is apt to break. To overcome these difficulties, pull the wrench with one hand and brace the tap with the other hand in a reverse direction to the pull of the wrench.

A slightly rounded chisel edge (for metal) will not break as quickly as if straight across. The straight-ground chisel, if not held squarely, will receive the full force of the blow at one spot, while the rounded point will center itself.

Never use oil out of an old tramp oilcan for oiling a piece of machinery. Rather throw out the old oil, rinse the can with kerosene, and refill with fresh oil.

Keep all of your tools clean and well oiled to prevent rust and deterioration. It is always a pleasure to reach for and use well kept and perfectly conditioned tools.—JOE V. ROMIG.

Tilting Porcelain Top Doubles Size of Kitchen Table

MY KITCHEN table can be extended when necessary to seat six or eight persons, and yet ordinarily it takes up no more room and is just as convenient as any other kitchen table.

The extension is an extra porcelain top, obtainable in any ordinary size at depart-

The table with the extension porcelain top down (at right), and with the top raised and supported by legs that slide out from under the table proper (below)



ment stores. It is fastened to the back of the table with two loose pin hinges and can be removed entirely by taking out the pins. When in a raised position, this top is supported, as shown, by extra legs and side rails that slide out from underneath the table proper.—GEORGE DRASCHE, Long Island City, N. Y.

REMODELING old furniture is a profitable pastime. Captain E. A. McCann will tell what he has accomplished in an interesting article next month.

Squab Book FREE



Squabs selling at highest prices ever known. Greatest market for 20 years. Make money breeding them. Raised in one month. We ship everywhere our famous breeding stock and supplies. Established 23 years. Write now for big illustrated free book, How to Make Money Breeding Squabs. **PLYMOUTH ROCK SQUAB CO.** 616 H St., Melrose Highlands, Mass.

GROW TALLER!



INCREASE YOUR HEIGHT

Develop your Physical Beauty. Natural, simple Method. Will increase your height and improve your appearance. Write for Free Booklet. Dept. F.

THE NATURAL METHOD BUREAU, Atlantic City, N. J.

No Joke To Be Deaf



—Every Deaf Person Knows That. I make myself hear after being deaf for 25 years with my Artificial Ear Drums. I wear them day and night. They are perfectly comfortable. No one sees them. They stop head noises. Write me and I will tell you a true story, how I became deaf and how I make you hear. Address: **Geo. P. Way**

Artificial Ear Drum Co., Inc. 86 Mc Kerchey Bldg. 2631 Woodward, Detroit, Mich.

Get More Eggs—Save Feed

How to cull poor layers—simple, easy-to-apply methods, outlined in new Free Book, "Dollars and Sense in the Poultry Business."



insures big egg yield and saves feed. Hundreds of poultry secrets, 96 pages, fully illustrated, written by T. E. Quisenberry, one of America's foremost poultry authorities. Sent FREE. **AMERICAN POULTRY SCHOOL** Dept. 1822 Kansas City, Mo.



Start Little Mail Order Business

Home employment evenings.

FREE BOOK

Beginner's Outfit furnished. Also tell you easy way to get Agents to sell your novelties. Book sent free. Pier, 553 Cortland St., New York

BE AN ARTIST

ARTISTS EARN BIG MONEY

Turn your talent into money. We can teach you drawing in your home during spare time. Well-trained artists earn from \$40 to \$200 a week. Thousands of publishers and advertisers need the work of good artists. The MODERN METHOD is an easy way to learn to draw original pictures. Write today for full particulars showing opportunities for you. State your age. **MODERN INSTITUTE OF ART** Dept. 42 7 East 42nd Street, New York City

Wrestling Book FREE



Learn to be an expert wrestler. Know scientific wrestling, self-defense, and jiu-jitsu. Develop a splendid physique, and have perfect health. Join this popular school and learn by mail. The famous world's champion—the marvelous

Frank Gotch and Farmer Burns

offer you a wonderful opportunity. Wrestling is easily and quickly learned at home by mail. Men and boys write now for splendid free book. Learn all the science and tricks. Be able to handle big men with ease. Accept this wonderful offer NOW. Send for free book today, stating your age. **Farmer Burns School of Wrestling**, 1782 Range Bldg., Omaha, Neb.

\$3 Cash Buys Typewriter



Balance Only \$5 Monthly

Save 35 to 60% on all standard makes—Underwood, Royal, Remington, etc. Every machine thoroughly rebuilt and GUARANTEED. Try five days at our expense before you buy.

WRITE at once for Free Descriptive Circular and Special Low Prices.

Wynn Typewriter Exchange 21 Reliance Bldg. Kansas City, Mo.

HOME STUDY

Become More Efficient

through courses in Mathematics, History, English, Chemistry, Psychology, Education, Business

and 35 other subjects which the University gives by mail. They command credit toward a Bachelor degree and may be begun at any time.

The University of Chicago 25 Ellis Hall Chicago, Ill.

BE A HOTEL EXECUTIVE

EARN \$2,500 TO \$12,000 A YEAR

YOU Can Be A Big Success

Splendid opportunities for you in the rapidly expanding hotel business. Many new openings leading to positions paying \$2,500 to \$12,000 a year and higher. First choice given to you—if you're trained.

We train you. We have trained many men and women, now occupying good positions as stewards, chief room clerks, housekeepers, linen clerks, heads of restaurants and tea rooms, department mgrs., etc. One of many enthusiastic graduates says, "I am leaving to take the fine hotel position you secured for me." Another—"I have accepted position as housekeeper—the manager hired me without any experience because I am one of your students." Another without hotel experience, is now stock-room supt. after a few weeks' study.

Advance Rapidly

America's leading hotels are constantly asking us to fill good positions—more requests than we can supply. Women needed also in hundreds of restaurants, tea rooms, clubs and cafeterias. Prepare in few weeks' spare-time study at home. Methods endorsed by leading hotel executives. Cost moderate; terms easy. We help you get a position. Send today for Booklet H-167. Save this ad as a reminder.

STANDARD BUSINESS TRAINING INSTITUTE
Carlton Court, Buffalo, N. Y.



Room Clerk
\$300 Advance



Advanced to
stockroom
supt. — Meals
furnished.



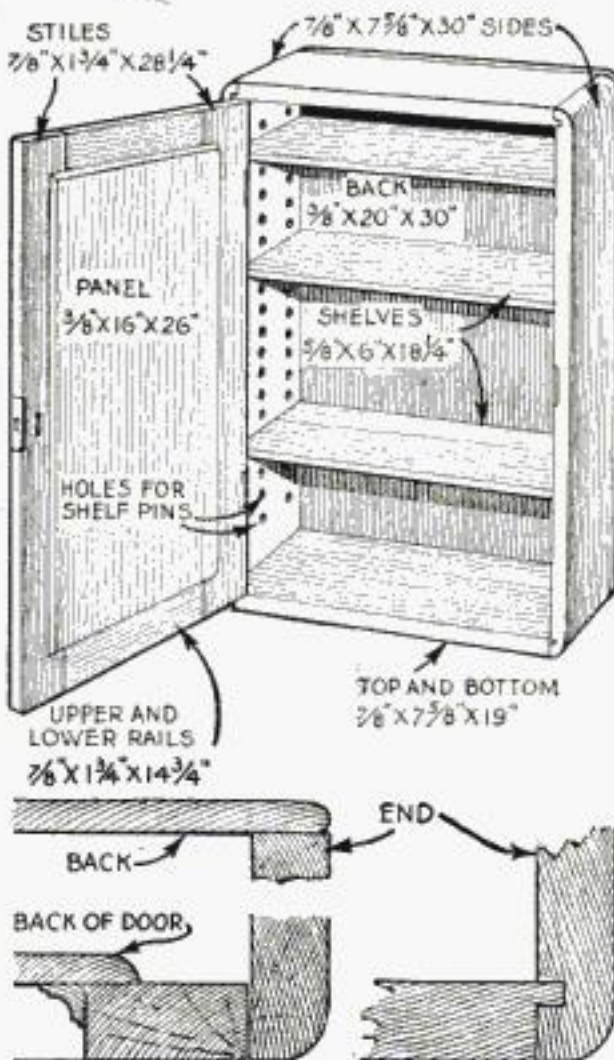
Tea Room Mgr.
Within 4 mos.

Cabinet Holds Home Workshop Stains and Chemicals

IN RESPONSE to the requests of readers, this cabinet has been designed to hold the stains, colors, and other chemicals required in the average home workshop. A list of the essential chemicals was given in the first of the Home Workshop chemistry series in September, 1923. There is room for these and a number of extra chemicals in the cabinet, as well as space for small scales, spoons and jars.

The cabinet may be constructed of any close-grained wood such as birch or white wood if it is to be enameled, or any suitable wood if it is to be stained or painted.

Make the joints neatly. Bore two rows of holes for the shelf supports in the end



The Home Workshop chemical cabinet and method of making the joints and door

pieces 1 1/2 in. apart, beginning about 6 in. from the bottom and ending 4 in. from the top. Round the edges, as shown, to a perfect quarter round, after the parts have been nailed and glued together. Bead or round the edges of the back and, after squaring the case, nail on the back.

The door frame may be doweled or nailed together with 3-in. finishing nails. The edges of the back of the door are rounded and the back is fastened in place with brads after the door frame has been squared. A panel molding improves the appearance of the door, but is not essential.

Two plain boxes with fronts 4 by 6 in. and two with fronts 5 by 6 in., all not more than 5 1/2 in. deep, may be made to form small bins for the bottom compartment. The cabinet may be hung with the long edges horizontal, if preferred, provided chains are used to hold the door when open; the back of the door then serves as a sort of worktable.

Beside the material indicated in the illustration, a dozen shelf pins, a lock, a knob, and hinges are required.

new! Spiral Ratchet Screw Driver No. 61 an Achievement

FOR two years we've been perfecting a smooth-working, sturdy and handsome Spiral Ratchet Screw Driver. It has stood up under every test.

No. 61 will meet all your screw driver requirements and do it in a better way. The last word in screw drivers—ask to see it in your own hardware dealer's.

Works three ways; locks tight in position; spiral action for driving or withdrawing screws; right or left hand ratchet action, extended or closed; rigid screw driver, extended or closed. Markings on sleeve indicate each action.

Specifications:

Spiral or rod, steel, accurately machined; Spiral nuts, manganese bronze; Ratchet Pawls, tool steel, hardened; Handle, stained hardwood; Blades (3), special steel, each blade individually tested; Locking device, absolutely rigid in action; Length, extended, bit inserted—20 1/2 inches.

All exposed parts highly polished and nickel plated.

MILLERS FALLS COMPANY

Millers Falls, Mass.
28 Warren St., New York
9 So. Clinton St., Chicago

Manufacturers of
Mechanics' Tools, Hack
Saws & Automobile Tools

MILLERS FALLS TOOLS
SINCE 1868



Make Money Taking PICTURES



Tremendous, big-paying opportunities are open for ambitious men in Modern Photography. This is the picture age. Magazine and newspaper publishers buy thousands of photographs each year. Every manufacturer sends out high priced pictures of his products. Every home wants portraits.

Photography is a business running into millions of dollars each year. And there is a great shortage of trained photographers.

EARN \$3,000 TO \$10,000 A YEAR

Hundreds of men are earning big money and establishing their own businesses. Even during spare time, while training, you can make \$75 a week easily—no matter where you live!

Get \$100 for Flood Pictures

"I took pictures of a flood and sold them for \$100. I have been able to buy my house and lot from the sale of pictures."

C. M. COLE, Washington.

\$97 in Two Days!

"I made \$285 in December. Went out two days last week on home portrait work and made \$97."

A. G. HUGHES, Kentucky.

Amazing New Easy Method

I show you, at home, how to do the kind of work turned out by the big studios in New York and Chicago! I show you how to make big money within 30 days! C. M. Cole bought a home with money he had made when only half way through his training. So well do I know what I can do for you that I guarantee under bond to return every cent of your tuition if you are not thoroughly satisfied.

Professional View Camera Free!

Write at once for Free Camera Offer—I give you, free, a splendid professional view camera. You will be astonished and delighted. This offer open for short time only—so act quick! No obligation.



INTERNATIONAL STUDIOS, Inc.
Dept. 2382 3601 Michigan Avenue, Chicago, U. S. A.

WRITE JOKES

Earn From \$50 To \$150 Per Week

writing jokes, epigrams and humorous stories for publications. Tremendous demand for material. Our short course in Humor Writing teaches you to write humorous material that sells. Learn in your spare time—earn in your spare time. Complete marketing plan and markets furnished.

Write for full particulars
American Institute of Humor
Office K 414 Park Bldg. Cleveland, Ohio



HERE'S A REAL BUSINESS!

MONEY AT HOME

Start permanent business. Everything furnished. Work anywhere, only table room required. \$25.00 to \$75.00 weekly operating Tangley Art Portrait Landscape Painting Business. No experience necessary. Hundreds successful workers. Quickly learned in 10 lessons. Free booklet. We employ you. Tangley Company 217 Main, Muscatine, Iowa



Kind words from a smoker in far Australia

A more modest manufacturer might not print this letter.

Nevertheless, when an enthusiastic pipe-smoker thousands of miles away takes his pen in hand to say something nice about Edgeworth, a breach of modesty on the manufacturer's part should be forgiven.

"Chetwynd," Copeland Road,
Beecroft, New South Wales,
Australia

Larus & Brother Co.,
Richmond, Virginia, U. S. A.
Gentlemen:

Perhaps you are somewhat surprised to receive this letter from Australia, often referred to in England, our Mother Country, as "Down Under."

I have noticed in some of your American magazines that I subscribe to, testimony in praise of your splendid tobacco. It has occurred to me that, as one of the many smokers of the Edgeworth in this Southern Continent of Australia, I can also add my testimony and appreciation of your world-wide-known and excellent tobacco.

It must be over twenty years since I first tried your "Edgeworth Extra High Grade Plug Slice."

My tobacco-nist, one of the leading tobacco-nists of Sydney, had a trial consignment of the Edgeworth to test the taste of his customers.

Just at that time I was smoking several kinds of high-grade im-

ported tobaccos, but somehow I could not get any of them that exactly pleased my taste. Some brands were excellent for a while, and then deteriorated.

But from the first purchase of your Edgeworth I have found it absolutely of the one uniform standard, without any change during the whole twenty-odd years I have been smoking it. I have been so satisfied with it that I have never purchased any other make.

I have induced a great number of my friends and fellow officers to try Edgeworth, and most of them have the same high opinion of it that I have.

My wish is that your company may prosper and continue to manufacture the renowned Edgeworth, and that I and my fellow smokers of this "Fair Australia" may be spared to a good, ripe old age to enjoy your fragrant weed.

Yours sincerely,
(Signed) Thos. Skellett

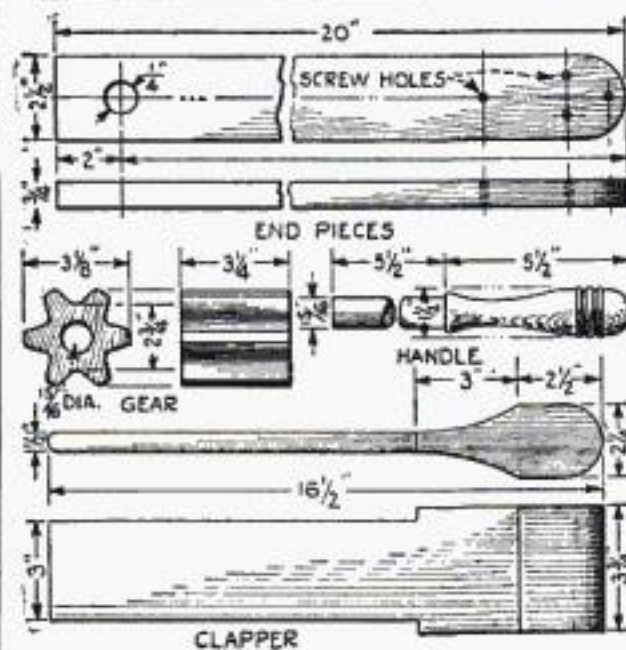
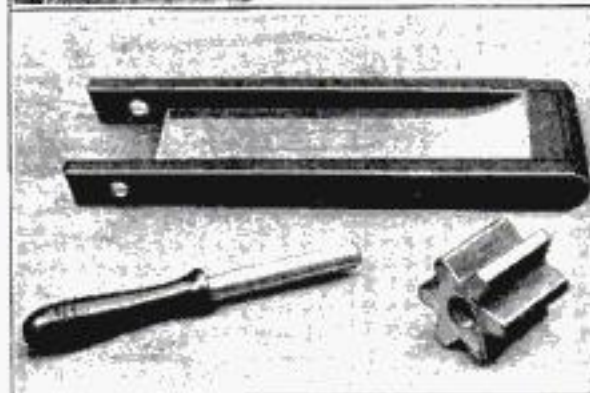
For free samples of Edgeworth—generous helpings of both Edgeworth Plug Slice and Ready-Rubbed—send a postcard with your name and address to Larus & Brother Company, 59 South 21st Street, Richmond, Va.

If you will also include the name and address of your regular "tobacconist," your courtesy will be appreciated.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Giant Noise-Making Rattle Can Be Heard a Mile

FOR any festive occasions when the average boy deems a large amount of noise absolutely necessary, this giant noise-maker will be found infinitely safer than revolvers, toy cannons, and other dangerous explosive devices. It can



The rattle assembled and disassembled, and details showing how the five wooden parts are shaped

be heard easily a mile away, yet any boy can make it with the simplest tools.

Oak is perhaps the best wood to use for durability and loudness. The shape and sizes of the five parts are made clear in the illustrations.—JOHN H. SCHALEK, Pittsburgh, Pa.

Getting Rid of Old Glue

IN REGLUING joints that have been previously glued, a good job cannot be done unless the old, hardened glue is removed entirely. In many cases it is extremely difficult to scrape off the glue. For instance, a piece often is split so that the surface presents an intricate series of ridges and hollows, which must fit together accurately. To clean off the glue on such a joint use a stiff brush—an old nail brush will do—and hot water. This will do the work effectively and leave the surface in the best possible condition for re-joining. Allow the wood to become thoroughly dry before making new joint.



DO YOU LIKE TO DRAW? CARTOONISTS TRAINED BY W. L. EVANS MAKE MONEY

Some of the cleverest cartoonists are former students. They had no experience before enrolling, but worked at the lessons during their spare time and found CARTOONIST EVANS' METHOD "easy to learn" and are now making good money. It is not hard to learn to draw originals when shown in a practical way.

The School is recommended by well known cartoonists because they know the students are handled right.

If you like to draw and want to be able to sell your drawings, send a sample of your work (either a copy or an original) and let us see what you can do. We will send you the portfolio of cartoons and full details about the school.

The Course is NOT EXPENSIVE



THE W. L. EVANS SCHOOL
OF CARTOONING

825 Leader Bldg., CLEVELAND, OHIO

Reduce Your Waist in 10 Seconds



BEFORE

You can actually do it now with the "Wonder" Health Belt. It will take only the time required for adjusting the belt around your waist to accomplish this reduction and to bring relief from the strain of excess weight, which your abdominal muscles are carrying. You will be agreeably surprised at the immediate relief from bodily fatigue and discomfort. You will know the satisfaction of again having a well poised figure. And, best of all, the fat begins, at once, to depart. Then good healthy muscular tissue replaces it. In a month or so, you can take from 4 to 6 inches off your waist.



AFTER

THE "WONDER" HEALTH BELT will do these things. It is scientifically constructed from strong, light-weight fabric. Easily adjusted and easily washed.

TRY IT AT OUR RISK

We will send this Wonder Health Belt for 5 days' trial at our risk. Send your name, address and present waist measure. If no tape is handy cut a piece of string to the proper size and mail it to us. When postman delivers belt, deposit only \$1.00 with him. If 5 days' using proves it helps you, send balance of \$2.00 in full payment, otherwise return and get your dollar back without question. Send today.

WEIL HEALTH BELT COMPANY, INC.
102 Hill Street, New Haven, Conn.

BURN Home Made GAS In Your Old COAL STOVES

Change your coal or wood stove into a gas stove in 3 minutes. A Child can do it. Burn kerosene Vapor Gas—hotter than coal or wood and costs less. Safe and simple.

FREE TRIAL

Just turn a valve and get even heat instantly. No ashes, no dirt, no smoke, no wood to chop or carry. No fires to build and feed. No fuel wasted. Cooks and bakes better. No damage to stoves. Makes its own gas from common coal oil, cheapest, cleanest fuel. Guaranteed five years. Money back if not satisfied after 10 days' trial. Write for FREE folder with proof and SPECIAL OFFER.

SIMPLEX UTILITIES MFG. CO.
215 Simplex Bldg. 1428 No. Wells St., Chicago

Sent On Approval 21 Jewels



No Money Down

Without one penny of advance payment let us place in your hands to see, to examine, to inspect, to admire, to approve, a real masterpiece in watch creation. A watch guaranteed to last a lifetime, which passes the most rigid inspection and measures up to the exacting requirements of the Great Santa Fe Railway System, and other great American trunk lines.

Page 12 of our Watch Book is of Special Interest to You

Ask for our Watch Book free—then select the Watch you would like to see, either the famous Santa Fe Special or the 6 position Bunn Special, and let us explain our easy payment plan and send the watch express prepaid for you to examine. No Money Down. Remember—No money down—easy payments buys a master timepiece—a 21 Jewel guaranteed for a lifetime at about half the price you pay for a similar watch of other makes. No money down—a wonderful offer.

SANTA FE WATCH COMPANY

289 Thomas Bldg., Topeka, Kansas
(Home of the Great Santa Fe Railway)

Santa Fe Watch Co.,
289 Thomas Bldg., Topeka, Kan.

Please send prepaid and without obligation your Watch Book free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

Name.....

Address.....

Toy Coaster Wagon Is Motorized for Nine Dollars

NINE dollars was all it cost to turn a toy coaster wagon into the "automobile" illustrated. The gasoline engine, which had once driven a washing machine, was bought at a second-hand store for five dollars; the rest from an old Ford, cost only a trifle, and the battery, at three dollars, was one of the heaviest expenditures.

The engine is attached to the bottom of the bed near the rear end of the coaster.



A gasoline engine from an old washing machine propels the coaster smoothly on paved roads

It drives one of the rear wheels by means of cog wheels and a chain taken from an old bicycle.

The handlebars and post of the same broken-down bicycle serve as the steering gear, the prongs at the bottom of the post being spread and bolted to the front axle. The steering, however, is done mainly with the feet.

While the power is not sufficient to pull the coaster on dirt or rough roads, the machine runs well on sidewalks and paved streets.—B. F. CLARK, Hutchinson, Kan.

One Man Raises Old Fence Posts with Powerful Puller

A FARMER in Tippecanoe County, Ind., uses the homemade puller illustrated for raising posts. The discarded wooden tongue is mounted on two old binder truck wheels and a hook and chain



Made of odds and ends, this puller saves the time and labor of digging posts

are fastened to the lower end so that the chain can be fastened around the post. By throwing his weight on the other end of the pole, the farmer pulls up the post faster and easier than it could be dug out by hand.—J. C. ALLEN, West Lafayette, Ind.

We Will Make You An ELECTRICAL EXPERT In 3½ Months At Coyne

Earn \$65 to \$200

A Week, Or Go In Business
For Yourself And Make

\$3500 to \$15,000

A Year

YES. 3½ months at the Great School of Coyne, located in Chicago, The Electrical Center of the World, will make you an Electrical Expert capable of commanding big pay. The whole world of electricity is open to the practical man—the man who has had actual experience with electrical apparatus. Coyne gives you a practical training on the greatest outlay of electrical apparatus of any institution in the World; everything from door bells to power plants.

Not a Correspondence School

We don't make you a mere "paper" electrician. We train you by practice on our mammoth outlay of actual equipment. We train you in house-wiring by having you do it exactly as it is done outside—not just by reading about it. The same applies to armature winding, power plant operation, motor installations, automotive work and hundreds of electrical jobs. That's why we can train you to become a Master Electrical Expert.

No Books—No Lessons—No Classes You Do Actual Work

The Coyne practical course includes no books, printed lessons or useless theory. We train you to work with your head and hands on the same kind of electrical apparatus as you will find "out in the field". Age, lack of experience or education is no drawback. Our students range from 16 to 60 years of age. Coyne gives you Free a Life Scholarship which enables you to stay as long as you want without extra charge or return later for more practice, and assists you to a position after graduation. We also include Free a Radio course.

Earn while you learn! We help students to secure jobs to earn a good part of their living expense while studying.

Send for Free Book

Send the coupon today for the Big Free Book which shows the Great School of Coyne and a great part of our massive electrical equipment. When you read the enthusiastic letters of Coyne graduates, you will be convinced that the only place to get a practical training is in the Great School of Coyne.

COYNE
Electrical School

Endorsed by Electrical Industry

1300-1310 W. Harrison St., Dept. 13-62 Chicago, Ill.

Coyne Electrical School, Dept. 13-62

1300-1310 W. Harrison St., Chicago, Ill.

Dear Sir: Please send me free your big catalog and full particulars of your special offer.

Name

Address

AGENTS Something New!

HERE'S the latest bonanza for live wires—the Burns Bread Knife. Entirely new patent. Different from all others. Cuts bread clean without tearing or making crumbs. Lasts for years. Retail for only \$1.00 or can be used as a premium with our line of over 200 fine household specialties.

14 in.

Long

\$8
\$10
a Day

Here's proof that we have a winner. LONGCORE, N. J., made \$14 in five hours; FRANK, Nebr., averages \$1.00 per hour every working day. MRS. MOSER, Pa., says it is easy to make \$10 a day with our line. Some good territory still open, but write quick for terms and free Outfit offer.

C. H. STUART & CO.

968 Union Street Newark, New York

SPORT BODIES for FORD and CHEV. 490 at \$34.50 UP

Life-size paper patterns—You can build your own body at a cost of \$11.00! We are manufacturers and our quantity production enables us to quote exceptional low prices. Our unique shipping methods save you 75% in FREIGHT CHARGES. Send at once for free particulars on Central Bodies. Our Book "HOW TO BUILD A FORD RACER" sent anywhere on receipt of 25c in cash or stamps. WRITE TODAY!

CENTRAL AUTO SUPPLY CO. Dept. 122, LOUISVILLE, KY.

MECHANICS' HANDBOOK



330 PAGES

More than 300,000 sold

HANDIEST book of its kind ever written. Prepared by experts under the direction of the International Correspondence Schools. Written in language that you can understand. Note this partial list of subjects:

Only \$1

Weights and Measures; Easily Understood Mathematics; Formulae; Mensuration; Belting; Hydro-mechanics; Strength of Materials; Boiler Design; Care and Inspection of Boilers; Horsepower of Boilers; Chimneys; Exhaust Heating; Machine Design; Horsepower of Engines; Boilers and Pumps; The Slide Valve; Belt Pulleys; Rope Belting; Cylinders and Steam Chests; Electricity; Currents; Wiring; Dynamos and Meters; Batteries; Cable Testing; Compass Surveying; Curves; Leveling; Etc.

Just mail this advertisement with a dollar bill and your name and address, and this 330-page I. C. S. Mechanics' Handbook or any of the other I. C. S. Handbooks that you want will come to you by return mail.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 7675-C, Scranton, Penna.

I enclose \$..... for which send me, postpaid, the Handbooks marked X, at \$1.00 each. It is understood that if I am not entirely satisfied I may return any or all of them within five days and get my money back.

☐ MECHANICS' HANDBOOK
☐ Automobile Handbook ☐ Radio Handbook
☐ Electrical Handbook ☐ Salesman's Handbook
☐ Chemistry Handbook ☐ Advertising Handbook
☐ Building Trades Handbook ☐ Bookkeeper's Handbook

Name.....

Address.....

Sewing Cabinets Built at Home

(Continued from page 81)

indicated. The posts are $1\frac{3}{8}$ by $1\frac{3}{8}$ by $25\frac{1}{4}$ in., plowed to take the plywood end panels, which are $\frac{1}{4}$ by $10\frac{1}{2}$ by 18 in., and the back panel, which is $\frac{1}{4}$ by $12\frac{1}{2}$ by 18 in. The top drawer front is $\frac{3}{4}$ by $3\frac{1}{2}$ by $11\frac{3}{4}$ in.; the center drawer front, $\frac{3}{4}$ by 2 by $11\frac{3}{4}$ in., and the bin front $\frac{3}{4}$ by 10 by $11\frac{3}{4}$ in. The drop leaf is supported by an ornamental iron bracket or a hinged wooden bracket.

In finishing either cabinet, the wood should be stained, filled, and given several coats of thin white or orange shellac, each rubbed with pumice-stone and crude or raw linseed oil. Several coats of good furniture wax can then be applied, if desired. For a varnished finish, stain and fill the wood and give one coat of white shellac and two or three coats of varnish, rubbing the last coat with pumice-stone and oil.

Both the cabinets were designed by George F. Kaercher especially for POPULAR SCIENCE MONTHLY. The complete working details and bills of materials are contained on a single large blueprint (No. 31), which can be obtained by sending 25 cents to the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

How to Cover a Ceiling with Wallboard Single-Handed

ANY one who has attempted to cover a ceiling with wallboard, especially with large sheets of heavy gypsum board, knows how difficult it is, even with a helper or two.

I have overcome the usual difficulties, however, by the simple expedient illustrated. Take two boards about 6 in. wide and as long as the room is wide. Hinge one end of each board to the plate or studding, spacing the boards apart about one third the length of a sheet of wallboard, and below the ceiling, the thickness



The sheets of wallboard are hoisted to the ceiling on two long, hinged boards

of the wallboard. Nail a cleat on each board about 3 ft. from the free end.

A rope is tied around the free end of each board about 2 ft. from the end of the board and passed over pulleys attached to the joists or rafters above.

The wallboard sheets are then placed on the two boards and drawn up to the ceiling. The loose ends of the rope are tied to spikes driven in the studs. It is then comparatively easy to shift the wallboard sheets into position and nail them.

A piece of flooring as long as the room is high, with a short piece nailed on the end in the form of a T, is a help in shifting the sheets.—M. VANSLYKE, Jacksonville, Fla.



Earl Roberts, tenor-banjo artist with the famous Westphal Orchestra, Columbia record artists, uses and endorses the New Gibson Mastertone Banjo.

You, Too, Will Appreciate the New Gibson Mastertone

The same qualities of this tenor-banjo which have captured artists in the great recording orchestras will win you, whether you take up the banjo for pleasure alone, or for the wonderful opportunities for profit which it affords.

No instrument is more popular today than the banjo. Only in the Gibson Mastertone can you obtain the Gibson Rim and Ball Bearing Tone Tube Construction, The Gibson Tone Projector and the other exclusive Gibson construction features which make it easier to play, marvelous in tone quality and carrying power, and absolutely dependable.

FREE BOOK. Send for your copy and details of Easy Payment Plan on any Gibson instrument, including Tenor-Banjo, Mandolin-Banjo, Guitar-Banjo, Cello-Banjo, Mandolin, Mandola, Mando-Cello, Guitar, Harp-Guitar and Mando-Bass. Mention instrument when writing.

205 GIBSON MANDOLIN-GUITAR CO.
Parsons Street Kalamazoo, Michigan

Gibson

We Teach
COMMERCIAL
ART

Meyer Both Company, the largest Commercial Art Organization in the World offers you an unusual opportunity for practical training, based upon twenty-three years of success. This nationally known organization each year produces and sells to advertisers over 15,000 commercial drawings. Meyer Both instruction is the difference between successful fact and experimental theory. This well paid profession equally open to men and women. Home study instruction.

Get Facts Before You Enroll in Any School

Ask the Advertising Manager of the leading newspapers in your city, anywhere in the United States, Canada, England or Australia about the Meyer Both Company—let them tell you about us. Write for our illustrated book telling about the success of our students—for one-half the cost of mailing—four cents in stamps.

MEYER BOTH COMPANY
Department of Art Instruction

Michigan Ave. at 29th St., Dept. 35, CHICAGO, ILL.

Note—To Art and Engraving Firms: Secure practical artists among our graduates. Write us.

MAKE YOUR FORD INTO A SPORT CAR ONLY \$6.40
Other types down to \$3.60. Famous sure fit, **Pal** life-size patterns and picture instructions show how. You can easily convert your Ford into this fast, saucy Sport Car as hundreds have done with a few dollars worth of material from the hardware store. No need to lay up the car. The "PAL" with conical disc wheel patterns. Pressed Metal Streamline Rear only \$6.40 delivered. Built low delivery. Send 5c coin for illustrated prospectus of Sport Bodies, "Judy" Tops and "Gosum" Windshields.
KUEMPEL CO., 526 Kuempel Bldg., Guttenberg, Iowa

LOOK FOR THE RED RING ON THE LUDEN-YELLOW BOX

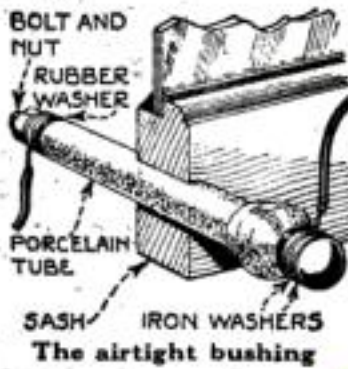
LUDEN'S
MENTHOL COUGH DROPS
GIVE QUICK RELIEF

\$25.00 in Prizes

See top of page 6 in front of book for details

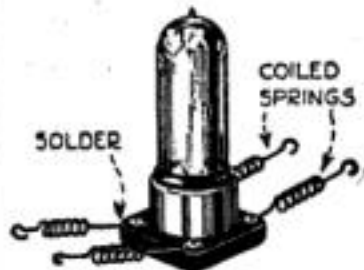
Improving a Porcelain Bushing Used for an Aerial Lead-In

THE porcelain tube ordinarily used as a bushing for insulating the radio lead-in where it enters through a window sash, frame, or window board, can be improved greatly by running a threaded copper rod or ordinary bolt through it, as shown. Rubber and iron washers at each end make the tube practically airtight and no cold air or rain can come in around the wire.—IRWIN E. WALTON, Bantry, N. D.



Spring Suspension Protects Vacuum Tubes from Jars

FOR mounting radio vacuum tubes flexibly, the most practical scheme I have found is that illustrated. Four brass springs are wound from spring wire, obtainable at hardware stores for about 10 cents a spool. The ends of the springs are soldered to the four terminals of the socket, and in this way they provide connections and shock absorbers at the same time.

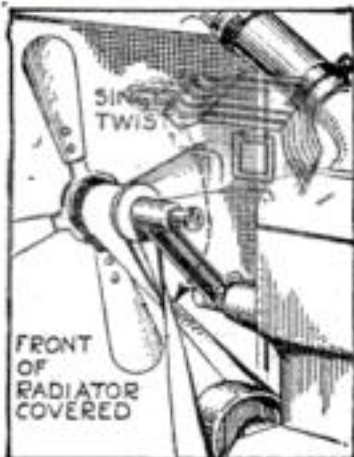


This method of tube insurance is well

worth the trouble, especially in portable sets. It should be remembered, too, that a vacuum tube after being used to some extent, should not be placed in a portable set without first protecting it in some such way, since the filament becomes brittle.—CARTER FISKE, New York.

Thawing Frozen Auto Radiator with Engine Heat

A FROZEN radiator often can be thawed out in an emergency by reversing the fan and blowing the hot air surrounding the engine through the radiator framework. Loosen the nut that holds the fan arm in position and lower this arm sufficiently to allow the belt to be crossed. Then raise the arm until the belt is tight on its pulleys and fasten it in place. When the engine is running, the hot air will be blown against the radiator cells and any ice will soon be melted.



THE soldering iron is a useful home tool. In next month's Home Workshop, Henry S. Laraby tells how to solder and Dr. E. Bade discusses solders and fluxes.

Sears, Roebuck and Co.

The World's Biggest Mail Order House



3,000 OHMS Head Set

At last—the inexpensive, efficient head set you've been looking for, and only \$2.98! Makes clear those distant signals. Fits your head as comfortably as your cap. Complete with six feet of good grade cord. Excellent workmanship. Order NOW! Shipping weight, 1½ lbs. Shipped from CHICAGO or PHILADELPHIA store.

57AB9220—...
Order Direct From
This Advertisement

\$2.98

FREE Radio Catalog!



Save On All Radio Supplies

Our big FREE Book shows hundreds of bargains in radio supplies and complete sets. Highest quality apparatus. Satisfaction guaranteed. This new, fascinating catalog tells "How to Build an Aerial." Complete list of broadcasting stations. Many new "Hookups." Write today! Ask for Radio Catalog No. 91P98.

Mail This Coupon NOW

Sears, Roebuck and Co.
Chicago — Philadelphia

Send me FREE Radio Catalog No. 91P98.

Name

P. O.

State

Rural Route

Box No.

Street and No.

\$25.00 in PRIZES

See top of page 6 of this issue for full details.

"Hart Heat"



IT IS HERE! The most wonderful heating appliance of the age. Burns a low test oil for fuel. Cheaper than coal. Eliminates dirt, soot, ashes, and work required in coal burning furnaces and boilers. Can be installed in any type of furnace now in the home.

We Want a Representative In This City

to supervise the demonstration, sales and installations of HART OIL BURNERS. No experience necessary. We teach you. Very little capital required. An established dealer preferred. Every Hart Oil Burner backed by manufacturers guarantee. 34 years in business. Wonderful money-making opportunity.

Write Immediately For Full Particulars

HART OIL BURNER CO.
PEORIA — ILLINOIS

BE A RAILWAY TRAFFIC INSPECTOR

EARN UP TO \$250
Expenses Paid



Per Month
Many Chances for Advancement In This Uncrowded Profession

Stanley W. Dress writes: "I have worked as a Traffic Inspector for some time and have found it the most satisfactory and pleasant work that I have ever been engaged in. The hours are short. In some places I work only five and six hours while in others I work eight hours. I have never worked over eight hours."

Many Opportunities To Travel

"This work has satisfied one of the ambitions of my life and that is traveling. There is no other work that gives more opportunities to travel than that of a Traffic Inspector and at the same time is interesting and instructive."



"I can recommend the course to anyone seeking a position that is pleasant and profitable and to which there is no end of advancement for the person who sticks to it. It requires so little of one's efforts and no one need stay at home to study it. The Course can be studied during spare time and any person with a common school education can easily make a success of it."

POSITIONS GUARANTEED Upon Graduation

Hundreds of Openings. We train you at home in spare time. Any average man can qualify in three months. We guarantee you a position upon graduation, paying at least \$110 per month and expenses, or refund what you have paid.

Unlimited Opportunities. Glen O. Trego writes: "I find that being a Railway Traffic Inspector does not only enable a man to receive higher positions in railways but it also verses one so he is more capable of conducting any kind of business which may be chosen for the future. I must admit that the price paid for the Course of Traffic Inspection is the best investment I ever made."

This interesting work places you in contact with high railway officials. Many opportunities to travel—or remain near home. **Railroads need more trained traffic inspectors—we must supply them.**

You take no risk! Send for full details of this unusual opportunity. Mail coupon today.



**STANDARD BUSINESS TRAINING INSTITUTE
BUFFALO, N. Y.**

MAIL COUPON

STANDARD BUSINESS TRAINING INSTITUTE
BUFFALO, N. Y.

Send me, entirely free, Booklet No. D-64, giving full particulars about course in Railway Traffic Inspection.

Name.....

Street.....

City.....

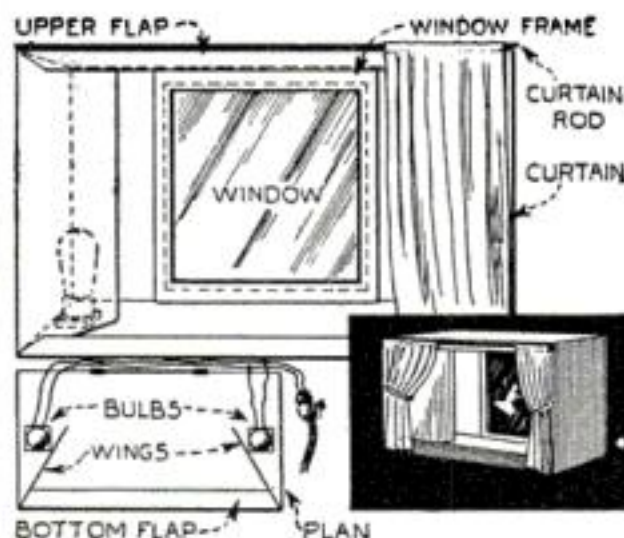
Cardboard Carton Forms Simplest Toy Stage

By H. S. Trecartin

AT DIFFERENT times I have made two "picture theaters," as the children call them. These seem to give them more lasting pleasure than do most of their toys. Children love to cut out the colorful and often really beautiful pictures from magazine covers and advertisements, and for such prints this "theater" furnishes an attractive setting.

Most of the materials can be had for the asking, and whatever has to be bought will not cost more than 30 or 40 cents. The whole job can be done in an hour's time with a knife and a screwdriver.

The stage is made of a strawboard carton or packing box. The flaps on one side are turned in at an angle to form the



Children enjoy displaying colored pictures cut from magazines in this easily made theater

wings, and an opening in the other side is cut to fit a piece of window glass.

Electric lamps, placed behind the wings, are hidden from the audience, but throw their light on the pictures, which are placed against the window from the back of the box. Cloth curtains are drawn to hide the change of pictures, and a switch operated from the back turns the lights on and off. The children immensely enjoy operating these simple details.

After the box flaps are glued together, the opening for the window may be cut to accommodate any small piece of glass at hand, about 6 by 8 in. or 8 by 10 in. The glass is fastened in the opening by strips of heavy paper.

Finishing Off the Corners

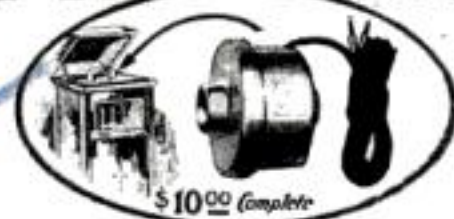
The narrower flaps at the front of the stage are pushed in and fastened at an angle of about 45 degrees. The top and bottom flaps are cut down to about 3 in. in width and the corners are clipped off so that they can be turned in at an angle.

These flaps can be secured by gluing with heavy paper, by fastening with thread and needle, or by tacking to small pieces of wood cut at the correct angles.

The stage may be decorated by pasting colored paper or wallpaper over it, or by painting it with oil or water colors. A cloth curtain should be provided; it may roll up on a rod or, better, be pulled each way from the center by two strings, carried around to the back.

Two cheap porcelain lamp sockets are
(Continued on page 125)

Morrison



Loud Speaker Enthusiastic

—is the only word that describes those radio critics who have chosen Morrison Loud Speaker. For them Radio has taken on new delights. Bright stars of the musical comedy stage, famous lecturers and singers all are theirs no matter where they live—every night as long as they care to stay awake.

Real reproduction without annoying vibrations as soft or loud as you please—that describes Morrison attached to your phonograph tone arm or used with a horn.

\$10.00

That's all Morrison costs complete with 5 foot cord Nickel Plated Model

This perfect little loud speaker has no rivals. We assure you your money back if you don't like it.

Ask for descriptive 2 color catalogue.

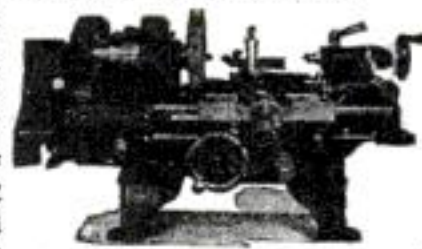
DEALERS:

Thousands of new radio fans have receiving sets—Christmas presents. Every one needs a Morrison Loud Speaker. We will show you how to merchandise Morrison. Ask us for our plan at once.

MORRISON LABORATORIES, INC.
341 Jefferson Ave. East - DETROIT, MICH.

A Most Efficient Tool FOR HOME WORKSHOP

The MON-ARCH Jr. Lathe is the ideal machine tool for the home workshop, repair shop and garage.



Turns out, with 1000th-inch accuracy, small wood and metal parts. Experimenters, inventors, mechanics are enthusiastic over it. Completely equipped; auto-safety devices; semi-quick change gear. Priced within your means.

\$245 9 inch Lathe—2½ ft. Bed—With Bench Legs

Also Built with bed lengths up to 5 feet. Made in 11-inch swing size too, at slightly higher price.

THE MONARCH MACHINE TOOL CO.
401 Oak Street Sidney, Ohio

For Pleasure or Profit

Boice-Built Bench Machines

The Pony Bench Machine shown here combines six machines in one: Saw, sander, drill, grinder, polisher and buffer. It saws 1½-inch stock with ease, and does mitering, dadoing, tenoning, etc. Easily driven by ¼-hp. or 1/3-hp. motor. Used in thousands of shops, both industrial and private. Boice-Built Bench Machines include larger Saws, Band Saws, Lathes, Drills, Jointers, and Motors. Write today for completely descriptive circular on any of these machines.

W. B. & J. E. BOICE
Dept. P. S. 2, 1730 Norwood Ave., Toledo, Ohio



Boice
Pony Bench
Machine

Price without
Chuck
\$32.50

The Opinion of 1,000 Others

To find out what influences ambitious men and women to enroll with the American School, an advertising agency sent out a questionnaire to one thousand names, taken at random from our student rolls. The answers to three of these questions show very clearly how our School is regarded by our students, both before and after enrolling.

Why Students Inquired About Our Courses

31.5% wrote only to the American School, because our advertisements impressed them more favorably than the advertisements of other home study schools.

27.0% had heard of the American School before.

23.7% answered several home study school advertisements, so they could select the best.

15.1% were recommended to our school by a friend or acquaintance who had taken one of our courses.

2.7% inquired for various other reasons.

Why Students Considered Taking a Course With Us

37.4% wanted to qualify for better positions.

22.5% wanted assistance in their present work.

20.7% wanted more information on the subject for which they enrolled.

11.2% wanted to prepare for college entrance examinations.

7.4% wanted to "brush up" on subjects previously studied.

.8% enrolled for various other purposes.

What Students Really Think About Our Courses

97.2% say our courses are "Good."

1.4% say our courses are only "Fair."

1.4% say our courses are "Not what they expected."

When you take the average opinion of 1,000 people, selected at random, about some one thing, you will get a definite idea as to the worth of the thing. The average opinion of these 1,000 people is that our courses are O. K. Do you need further proof? If you want to get ahead and are considering a course of practical training, you will find that the American School is the best place to get that training. From us you will get the best grade of training at the lowest cost. And further—

Our Money-Back Guarantee Protects You

You cannot lose when you enroll with us. If after you have finished your course you are not absolutely satisfied, if you do not believe that the training we gave you will help you to get ahead, just write us and we will refund to you every cent you paid us. Mark the coupon. Your request for information puts you under no obligation and no AGENTS WILL BOTHER YOU.

American School

Dept. G-275
Drexel Ave. and
58th St.
Chicago, U. S. A.



American School

The American School is not a money-making corporation, but like resident schools and colleges, is chartered strictly as an "Educational Institution, not for profit."

More than 200 famous engineers and educators prepared the special instruction papers for our students.

For over a quarter of a century, Big Engineers, Educators and Business Men have recommended the American School. They know that our long experience as an educational institution guarantees better training at less cost than can be given by any school conducted for profit.

COURSES TAUGHT

American School,

Dept. G-275, Drexel Ave. & 58th St., Chicago.

Gentlemen: Please send me full information on the subject checked. It is understood that this request places me under no obligation and that no agents will bother me.

- | | |
|-------------------------------------|--------------------------|
| .. Architect | .. Lawyer |
| .. Building Contractor or Carpenter | .. Machine Shop Practice |
| .. Automobile Engineer | .. Photoplay Writer |
| .. Automobile Repairman | .. Mechanical Engineer |
| .. Civil Engineer | .. Shop Superintendent |
| .. Advertising Manager | .. Employment Manager |
| .. Business Manager | .. Steam Engineer |
| .. Financial Manager | .. Foremanship |
| .. Sales Manager | .. Sanitary Engineer |
| .. Cert. Pub. Accountant | .. Surveyor (& Mapping) |
| .. Accountant & Auditor | .. Telephone Engineer |
| .. Bookkeeper | .. Telegraph Engineer |
| .. Draftsman & Designer | .. High School |
| .. Electrical Engineer | .. Fire Insurance Expert |
| .. General Education | .. Wireless-Radio |
| .. Personal Analysis | .. Business Law |
| | .. Undecided |

Name.....

Address.....

Occupation.....

Cardboard Carton Forms Stage

(Continued from page 124)

set behind the wings and connected with lamp cord carried through holes punched in the box to a socket switch. A drop cord from any house-lighting socket can be connected with this, if electricity is available. It will be just as easy, however, to connect up small dry-cell lamps and then the batteries also may be placed inside the stage.

Radio Soldering Copper Reaches Easily into Tight Corners

HOW to solder connections in awkward corners is a problem that frequently confronts the radio fan who builds his own sets. It is a great aid in such cases to have a soldering copper made as shown



Because of the heavy body this small soldering copper retains its heat for some time

by inserting a copper wire or rod into a steel, iron, or copper body about $\frac{3}{4}$ in. in diameter and from 3 to 5 in. long. A handle of any convenient length is then fitted to this head. The bulky part of the head retains enough heat to keep the point warm for a considerable time.—J. D.

Connecting an Extension Cord with Your Radio Phones

THE broadcast listener often wishes to share his headset, but finds it inconvenient because of the shortness of the cord between the two receivers. This is overcome without rewiring the phones by using two extensions preferably made of silk-covered wire of flexible tinsel.

The original cord is cut about 5 in. from one of the receivers, the cuts not being made exactly opposite each other. To

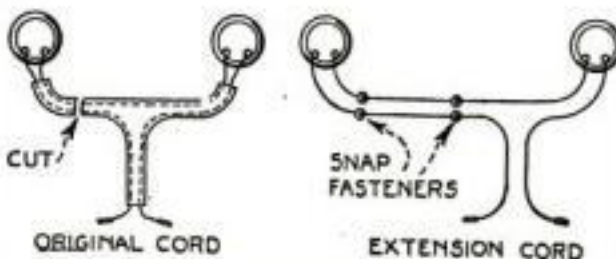


Diagram showing how the telephone cord is cut and two long extensions are inserted

each of the four wire ends thus produced is soldered one part of a large size snap fastener. The interlocking parts of the fasteners are soldered to the ends of two 10-ft. lengths of the new single cord, which can be purchased by the foot.

One must be careful not to mix up the connections. Usually a cord with marked insulation runs between the receivers, connecting them in a series, while a plain insulation is used on the cord from each receiver to the terminals. The new cords can be neatly sewed together in places with green silk thread to match the insulation.—KARL L. M.
Ohio.

Dental Laboratory



Learn to make Rubber Plates, Bridge Work, Crowns, Metal Base Dentures.

for Laboratories for each EXPERT of operating one!

60,000 DENTISTS NEED LABORATORY

Only a few hundred Laboratories in the U.S.—most of them in Chicago and New York. Dentists can't afford to do mechanical jobs. They can buy a Laboratory Expert at \$100 an hour, and they want better service than they can get now.

OPEN A LABORATORY your OWN!

Jow Wilk of Chicago started a couple of years ago ALONE. Today he employs 60 and his Laboratory is one of the big ones in the U. S. Boos of Chicago is reported to employ 125 men and to clear \$40,000 to \$50,000 a year. You can start your own Laboratory with as little as \$100 investment.

EARN While You LEARN!

Day students make all or part cost of course by part-time night work. Night students can find plenty of good jobs in Chicago to see them thru.

W. I. I. Help You!

Interesting Catalog FREE!

Catalog tells you how quickly and easily you can get ready, how hundreds of others have SUCCEEDED! Tells you how you learn in a few months BY DOING ACTUAL LABORATORY JOBS under world's greatest Mechanical Dentist! Brings you FREE R. R. FARE offer and other big inducements. Write for free catalog today!

McCARRIE SCHOOL OF MECHANICAL DENTISTRY

Dept. 302, 34 and 36 W. Lake St., Chicago

McCarrie School of Mechanical Dentistry Dept. 302, 34 and 36 W. Lake St., Chicago

Without obligation please send me your FREE R. R. Fare Offer and free catalog with complete information about how I may become a Dental Laboratory EXPERT.

Name.....

St. No. or R. F. D.



Mahoganite

the beauty of
ed mahogany

MOGANITE RADION
Panels have a satin-like
comparable to that which
and a skilled cabinet maker
to mahogany. Radion
and Knobs can also be
had in Mahoganite to match.

RADION
The Supreme Insulation
PANELS

18
Stock Sizes

6 x 7	7 x 21
6 x 10 1/2	7 x 24
7 x 14	7 x 48
7 x 21	9 x 14
7 x 9	10 x 12
7 x 10	12 x 14
7 x 12	12 x 21
7 x 14	14 x 18
7 x 18	20 x 24

Look for this
stamp on every
genuine RADION
Panel. Beware of
imitations.

Miniature Cedar Chest Sewing Boxes Find Ready Sale

WHILE confined to the house with rheumatism, I made use of my spare time in building miniature cedar chest sewing boxes from pieces of Tennessee cedar left over from large chests. They were made exactly like large chests, but lined with silk and with small pockets in the ends for spools and ribbons and were finished in the natural color with varnish. Being more or less of a novelty and very attractive, they sold at a good price, so that I dispose of all I can make.—EARL FORD, Bangor, Me.

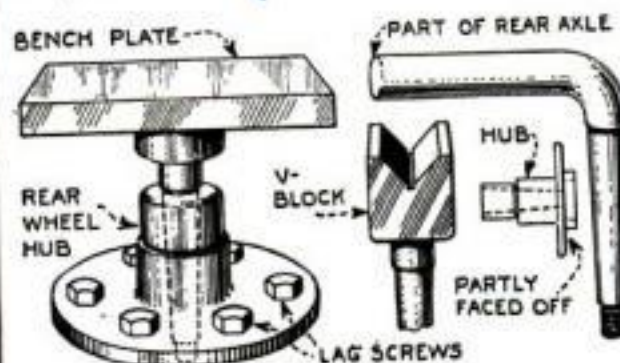


A cedar sewing box

Old Auto Hub Serves as Useful Bench Fixture

WORN out and discarded auto parts often can be worked up into serviceable tools for the home workshop. A handy fixture of this kind is illustrated.

A rear wheel hub from a smashed wheel is obtained and the side carrying the hub cap is faced off flush with the surface of the flange. This leaves the main part of the hub with a tapered bore, into which



A rear wheel hub forms swivel mounting for bench plate, V-block, and riveting anvil

fits the tapered end of the axle. The hub is screwed to the workbench.

Tools such as a bench plate, a V block, a bent riveting anvil and the like, each fitted with a rear axle shank, can be placed readily and quickly in the socket and revolved into the most convenient position. As the threaded end of each tool shank projects through the bore of the hub, an upward tap with a hammer will knock it out.

The castings for the bench plate and the V block are bored for a press fit over the turned end of the axle.

Refinishing an Old Table

AS I was passing a furniture store recently, I saw a black drop-leaf table, with clusters of flowers painted on the leaves. This gave me the idea of removing the dingy finish from an old gateleg table of my own and painting it with Japan black, a flat color. I then cut pictures of flowers from a magazine and pasted them on the center of the table and on the leaves. The table was given three coats of the black paint, the last coat being rubbed with fine stone and water.

Sell your snapshots

You can make your camera self-supporting by selling your pictures to "Popular Science." Mr. J. G. Pratt, of Washington, D. C., tells in a recent issue of *The Camera*, how he has made his camera pay for its upkeep. This is what Mr. Pratt says:

"Every red-blooded American finds himself at times in some little difficulty which he overcomes by the inventiveness of his own brain. These ideas are worth money, and if you will but take a photograph or make a sketch of the thing in hand and send it to the right publishers, you will not only have the satisfaction of having overcome the difficulty, but more often than not will receive a fair size check for your trouble. "For instance, the motorometer on my car insisted on wearing out the fiber washer, so that if screwed down tight, it would point forward instead of crossways. This I corrected by drilling a small hole in the lower flange, threading it and inserting a set screw. It worked fine, and I not only had the satisfaction of eliminating an unpleasant imperfection in the car, but a photograph of it brought me a check from Popular Science."

Popular Science Monthly is always ready to buy live photographs at good prices from amateur photographers. These need not necessarily concern the results of your own ingenuity. The shops and factories in your town, the hardware, automobile accessory radio and department stores are constantly showing new mechanical devices that will be of interest to Popular Science readers. Your neighbors are rigging up ingenious homemade appliances to aid them in painting their houses, operating their cars, radio sets. Good photographs of things of this sort, taken to show the operation of devices in human hands, are always in demand by Popular Science Monthly. So be on the lookout for a chance to make snapshots. Send them to The Camera Editor, and if they can be used we promptly send you a check.

Camera Editor

POPULAR SCIENCE MONTHLY
225 West 39th Street New York

Be the First to Use
Smooth-On No. 1
and Get the Credit
for the Saving!

SMOOTH-ON stops leaks in auto radiators, bursted water jackets, gear cases, tanks, heating boilers and radiators, tanks, water, gas and steam pipes, etc., in one simple application. Keeps bolts, nuts, grease cups, hub caps, etc., from loosening and dropping off. Makes handles tight on tools, kitchenware, door knobs, canes, etc.—Joins iron, brass, lead, aluminum, wood, concrete or glass each other, and holds well in many places where nothing else can.

Needed in every home, auto workshop and when used as directed makes big savings: stops many nuisances.

Get
This Book
Free

144-page
Repair Book
FREE

If you mention this magazine

Seven kinds of Smooth-On made each for specific purpose. Get Smooth-On No. 1 in 1-lb. or 5-lb. tin at nearest hardware store.

SMOOTH-ON
REPAIR
BOOK

SMOOTH-ON MFG.
Dept. 58
574 Communipaw Ave.
Jersey City, N. J.

What Do Chiropractors Mean

by Innate Intelligence ?

THE temperature of a normal human body is approximately 98.6 degrees. You may sit in a room the temperature of which is 80 degrees, or go out of doors when the thermometer registers zero and your temperature, if you are in health, will not vary a single degree, because, resident in your body is an intelligence that generates, distributes and regulates the heat of the body, and instantly adapts it to the change in temperature.

If you start in June to take a plunge in the lake every morning and continue it every day until December, this same power resident in the body will intelligently adapt the body to the seasonal change in temperature.

This innate power gave the polar bear his long hair, that he might live in the land of eternal ice, and the gentle deer his speed, that he might escape his less swift foe. It is this power that in the struggle for existence gave wings to the birds and cunning to the fox, spots to the leopard and strength to the lion. It is this power that elongated the neck of the giraffe so that he could reach the high-hanging foods and for obvious reasons webbed the feet of the duck and goose. This inborn power adapted the stomach of the carnivora to a meat diet, the stomach of the herbivora to a vegetable diet, and the stomach of man to both.

This power develops the body from a blastoderm to its full growth in thirty-five years; for ten or more it

maintains its vigor and then slowly lets the house in which we live decay. During all the circling three-score years and ten it coordinates the physical functions, heals the body's wounds, mends its breaks, adapts it to the change of season, occupation and pursuit and performs the miracle of changing common food into living, breathing, sensate bone and flesh.

It laughs at all our efforts to locate it or to imitate its work and yet some people, because they cannot find it, weigh it or measure it, question its existence and say "Vital force is a chemical phenomenon."

Call it what you will, it's there—a rose by any other name is just as sweet.

This "power within" Chiropractors call Innate Intelligence and all their philosophy, science and art is built upon this fundamental fact. They teach that "Innate Intelligence" functions through the brain and nervous system, and that disease is but the abnormal expression of one or more of the nine primary physical functions. Any pressure of a harder tissue (bone) upon the soft nervous tissue, impairs the conductivity (function or work) of that tissue and results in disease. All that is necessary for a complete restoration to health, is that the impinging tissue be adjusted to normal position, which permits the nerve again to function normally.

Scientists call the *modus operandi* of the "power within" the law of adaptation. Among the professions engaged in getting the sick well, chiropractors alone recognize the existence of the thing itself, and the law of its expression, through the nervous system.

That is the reason Chiropractic succeeds where all other methods fail.



DEFINITION

The practice of Chiropractic consists of the palpation and adjustment, with the hands, of the movable segments of the spinal column to normal position for the purpose of releasing the prisoned impulse.

Write for information regarding Chiropractors
or Schools to the

Universal Chiropractors' Association
Davenport, Iowa, U. S. A.



Establishing a New Horizon for Radio!

MU-RAD RECEIVERS

MA-15

FROM the greater heights of this latest MU-RAD achievement, larger possibilities for radio entertainment are brought within your reach. The new MU-RAD RECEIVER MA-15, combining the famous MU-RAD simplicity of operation and selectivity, with loud

speaker volume and clarity, is designed specifically for long ranges, with only a two foot loop. Well balanced appearance. Volt-meter for instant readings of "A" and "B" battery condition. Three stages of radio frequency amplification, with detector.

Guaranteed Reception—1000 Miles

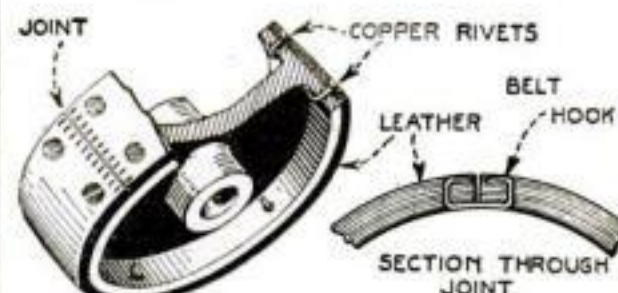
MU-RAD LABORATORIES Inc.
811 Fifth Avenue
Asbury Park
N. J.



Leather Improves Traction of Small Iron Pulleys

USERS of power-driven machinery often find that belts that run on pulleys of small diameter slip considerably. This is especially true in the case of threshing machines, which drive several shafts through one belt. In such cases the small iron pulleys can be made to grip the belt better if they are covered with leather.

Select a good piece of leather belting of suitable thickness and cut it so that when it is wrapped about the pulley, it will be



A piece of leather belting is cut to fit the pulley and fastened to it with sunken rivets

short by $\frac{1}{4}$ in. or more. Fasten the ends with wire belt hooks, such as are used on sewing-machine belts. Space the hooks evenly and hammer down the ends below the face of the leather. Then soak the leather in water for a few minutes so that it will stretch over the pulley. When in place, it is bound with cord or narrow strips of cloth and left to dry. Holes are later drilled through both leather and iron and rivets placed as shown.—J. R.

Seating a Small Ball Valve

IN MAKING small ball check valves, or other valves where the moving part is a steel or bronze ball, the important thing is to get the valve-ball well seated, so that it will bear evenly all around and be proof against leakage, yet free to move without sticking or binding.

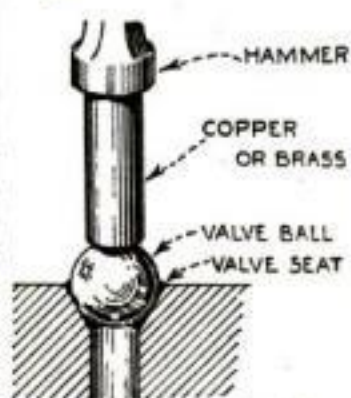
A simple and excellent way to attain this result is to form the seat first with a countersink or

specially ground tool having an angle of about 65 degrees, and then lightly hammer the ball into the seat, using a piece of copper or soft brass as a buffer between the ball and the hammer.

To be on the safe side, do not use the ball with which the seat

was made for the actual valve, but use a fresh one, hammering it in as before, but very lightly. This method makes a very good seat in brass.

Nothing is gained by making the bearing surface too wide. A seating width of $\frac{1}{32}$ in. is sufficient for a ball $\frac{3}{16}$ in. in diameter.



Hammering the ball makes a perfect seat

A SERVICEABLE scraper for delicate operations may be made from a draftsman's broken ruling pen. Simply grind to a knife edge the edge of that part of the blade remaining intact.—J. G. F.

A Coal-Saving of at least 20% is Guaranteed to every user of the CROWN Fuel Saver

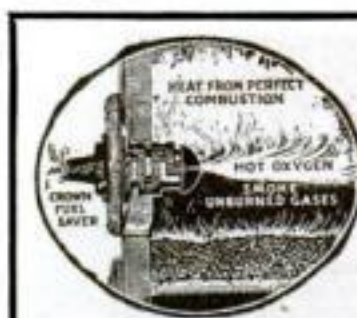
Guaranteed in this case means just what it says. There's no hokum about it, no "ifs" or "buts." Properly attach the CROWN Fuel Saver to the feed door of your heating plant and we guarantee you an actual saving in fuel of at least 20%—or we will refund your money without question.

Many users of the CROWN obtain fuel savings up to 50%.

Over 10,000 satisfied users of the CROWN are getting more heat, steadier heat and cleaner heat. They are cutting down their coal bills $\frac{1}{6}$ to $\frac{1}{2}$; eliminating smoke and deadly gases; and reducing the number of trips to fire the furnace.

What the CROWN is

The CROWN is a small device which may be easily bolted to the feed door of any type heating plant without injury to the door. The CROWN (see illustration) provides, by means of natural draft, an auxiliary supply of hot air over the surface of the fuel bed. This hot air (oxygen) burns the rich gases that are ordinarily lost thru the chimney in the form of "smoke." The CROWN turns this "smoke" into intense heat and assures almost perfect combustion.



Easily attached to the feed door of any heating plant

The CROWN FUEL SAVER works automatically. There's nothing to take care of; nothing to get out of order. It is easily installed without putting out your furnace fire.

Write today for details

Don't put off learning about the amazing heat-producing and guaranteed coal-saving powers of the CROWN Fuel Saver. Write today for details and prices and for our interesting free booklet "Making the Coal Bill Look Like 30 cents." As the CROWN comes in 4 sizes, give name and make of heating plant and approximate size of grate.

CROWN FUEL SAVER CO.
12 N. 10th St., Richmond, Ind.

Distributors Wanted—Write for interesting profitable proposition. Every home, business house and factory a prospect.



Mahoganite

the beauty of
ed mahogany

MOGANITE RADION
Panels have a satin-like
comparable to that which
and a skilled cabinet maker
to mahogany. Radion
and Knobs can also be
had Mahoganite to match.

RADION

The Supreme Insulation

PANELS

18

Stock Sizes

6 x 7	7 x 21
6 x 10 1/2	7 x 24
7 x 14	7 x 48
7 x 21	9 x 14
7 x 9	10 x 12
7 x 10	12 x 14
7 x 12	12 x 21
7 x 14	14 x 18
7 x 18	20 x 24

Look for this
stamp on every
genuine RADION
Panel. Beware of
substitutes and
imitations.



He Rubber Co.
New York

Miniature Cedar Chest Sewing Boxes Find Ready Sale

WHILE confined to the house with rheumatism, I made use of my spare time in building miniature cedar chest sewing boxes from pieces of Tennessee cedar left over from large chests. They were made exactly like large chests, but lined with silk and with small pockets in the ends for spools and ribbons and were finished in the natural color with varnish. Being more or less of a novelty and very attractive, they sold at a good price, so that I dispose of all I can make.—EARL FORD, Bangor, Me.

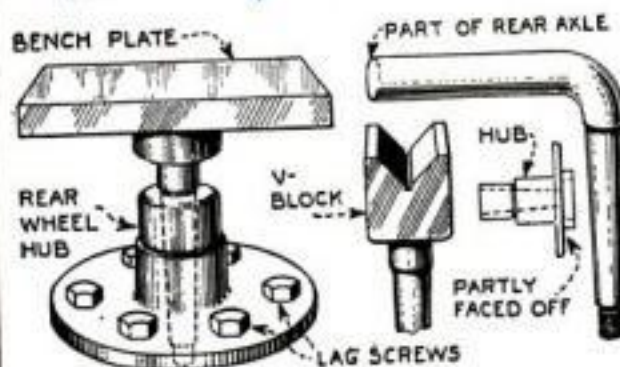


A cedar sewing box

Old Auto Hub Serves as Useful Bench Fixture

WORN out and discarded auto parts often can be worked up into serviceable tools for the home workshop. A handy fixture of this kind is illustrated.

A rear wheel hub from a smashed wheel is obtained and the side carrying the hub cap is faced off flush with the surface of the flange. This leaves the main part of the hub with a tapered bore, into which



A rear wheel hub forms swivel mounting for bench plate, V-block, and riveting anvil

fits the tapered end of the axle. The hub is screwed to the workbench.

Tools such as a bench plate, a V block, a bent riveting anvil and the like, each fitted with a rear axle shank, can be placed readily and quickly in the socket and revolved into the most convenient position. As the threaded end of each tool shank projects through the bore of the hub, an upward tap with a hammer will knock it out.

The castings for the bench plate and the V block are bored for a press fit over the turned end of the axle.

Refinishing an Old Table

AS I was passing a furniture store recently, I saw a black drop-leaf table, with clusters of flowers painted on the leaves. This gave me the idea of removing the dingy finish from an old gateleg table of my own and painting it with Japan black, a flat color. I then cut pictures of flowers from a magazine and pasted them on the center of the table and on the leaves. The table was given three coats the last coat being rubbed with wax and water.

Sell your snapshots

You can make your camera self-supporting by selling your pictures to "Popular Science." Mr. J. G. Pratt, of Washington, D. C., tells in a recent issue of *The Camera*, how he has made his camera pay for its upkeep. This is what Mr. Pratt says:

"Every red-blood American finds himself at times in some little difficulty which he overcomes by the inventiveness of his own brain. These ideas are worth money, and if you will but take a photograph or make a sketch of the thing in hand and send it to the right publishers, you will not only have the satisfaction of having overcome the difficulty, but more often than not will receive a fair size check for your trouble. "For instance, the motometer on my car insisted on wearing out the fiber washer, so that if screwed down tight, it would point forward instead of crossways. This I corrected by drilling a small hole in the lower flange, threading it and inserting a set screw. It worked fine, and I not only had the satisfaction of eliminating an unpleasant imperfection in the car, but a photograph of it brought me a check from Popular Science."

Popular Science Monthly is always read to buy live photographs at good prices for amateur photographers. These need not necessarily concern the results of your own ingenuity. The shops and factories in your town, the hardware, automobile accessory radio and department stores are constantly showing new mechanical devices that would be of interest to Popular Science readers. Your neighbors are rigging up ingenious homemade appliances to aid them in painting their houses, operating their cars, radio sets. Good photographs of things of this sort, taken to show the operation of devices in human hands, are always in demand by Popular Science Monthly. So be on the lookout for a chance to make snapshots. Send them to The Camera Editor, and if they can be used we promptly send you a check.

Camera Editor

POPULAR SCIENCE MONTHLY
225 West 39th Street New York

Be the First to Use
Smooth-On No. 1
and Get the Credit
for the Saving!

SMOOTH-ON stops leaks in auto radiators, bursted water jackets, gear cases, tanks, heating boilers and radiators, tanks, water, gas and steam pipes, etc., in one simple application. Keeps bolts, nuts, grease cups, hub caps, etc., from loosening and dropping off. Makes handles tight on tools, kitchenware, door knobs, canes, etc.—Joins iron, brass, lead, aluminum, wood, concrete or glass each other, and holds well in many places where nothing else can.

Needed in every home, auto workshop and when used as directed makes big savings and stops many nuisances.

Get
This Book
Free

144-page
Repair Book
FREE

If you mention this magazine

Seven kinds of Smooth-On made each for specific purpose. Get Smooth-On No. 1 in 1-lb. or 5-lb. tin at nearest hardware store.

SMOOTH-ON
REPAIR
BOOK

SMOOTH-ON MFG.
Dept. 58
574 Communipaw Ave.
Jersey City, N. J.



The Opinion of 1,000 Others

To find out what influences ambitious men and women to enroll with the American School, an advertising agency sent out a questionnaire to one thousand names, taken at random from our student rolls. The answers to three of these questions show very clearly how our School is regarded by our students, both before and after enrolling.

Why Students Inquired About Our Courses

31.5% wrote only to the American School, because our advertisements impressed them more favorably than the advertisements of other home study schools.

27.0% had heard of the American School before.

23.7% answered several home study school advertisements, so they could select the best.

15.1% were recommended to our school by a friend or acquaintance who had taken one of our courses.

2.7% inquired for various other reasons.

Why Students Considered Taking a Course With Us

37.4% wanted to qualify for better positions.

22.5% wanted assistance in their present work.

20.7% wanted more information on the subject for which they enrolled.

11.2% wanted to prepare for college entrance examinations.

7.4% wanted to "brush up" on subjects previously studied.

8% enrolled for various other purposes.

What Students Really Think About Our Courses

97.2% say our courses are "Good."

1.4% say our courses are only "Fair."

1.4% say our courses are "Not what they expected."

When you take the average opinion of 1,000 people, selected at random, about some one thing, you will get a definite idea as to the worth of the thing. The average opinion of these 1,000 people is that our courses are O. K. Do you need further proof? If you want to get ahead and are considering a course of practical training, you will find that the American School is the best place to get that training. From us you will get the best grade of training at the lowest cost. And further—

Our Money-Back Guarantee Protects You

You cannot lose when you enroll with us. If after you have finished your course you are not absolutely satisfied, if you do not believe that the training we gave you will help you to get ahead, just write us and we will refund to you every cent you paid us. Mark the coupon. Your request for information puts you under no obligation and no AGENTS WILL BOTHER YOU.

American School

Dept. G-275
Drexel Ave. and
58th St.
Chicago, U. S. A.

COURSES TAUGHT

American School,

Dept. G-275, Drexel Ave. & 58th St., Chicago.

Gentlemen: Please send me full information on the subject checked. It is understood that this request places me under no obligation and that no agents will bother me.

- | | |
|---|--|
| <ul style="list-style-type: none"> Architect Building Contractor or Carpenter Automobile Engineer Automobile Repairman Civil Engineer Advertising Manager Business Manager Financial Manager Sales Manager Cert. Pub. Accountant Accountant & Auditor Bookkeeper Draftsman & Designer Electrical Engineer General Education Personal Analysis | <ul style="list-style-type: none"> Lawyer Machine Shop Practice Photoplay Writer Mechanical Engineer Shop Superintendent Employment Manager Steam Engineer Foremanship Sanitary Engineer Surveyor (& Mapping) Telephone Engineer Telegraph Engineer High School Fire Insurance Expert Wireless-Radio Business Law Undecided |
|---|--|

Name.....
Address.....
Occupation.....

Cardboard Carton Forms Stage

(Continued from page 124)

set behind the wings and connected with lamp cord carried through holes punched in the box to a socket switch. A drop cord from any house-lighting socket can be connected with this, if electricity is available. It will be just as easy, however, to connect up small dry-cell lamps and then the batteries also may be placed inside the stage.

Radio Soldering Copper Reaches Easily into Tight Corners

HOW to solder connections in awkward corners is a problem that frequently confronts the radio fan who builds his own sets. It is a great aid in such cases to have a soldering copper made as shown



Because of the heavy body this small soldering copper retains its heat for some time

by inserting a copper wire or rod into a steel, iron, or copper body about $\frac{3}{4}$ in. in diameter and from 3 to 5 in. long. A handle of any convenient length is then fitted to this head. The bulky part of the head retains enough heat to keep the point warm for a considerable time.—J. D.

Connecting an Extension Cord with Your Radio Phones

THE broadcast listener often wishes to share his headset, but finds it inconvenient because of the shortness of the cord between the two receivers. This is overcome without rewiring the phones by using two extensions preferably made of silk-covered wire of flexible tinsel.

The original cord is cut about 5 in. from one of the receivers, the cuts not being made exactly opposite each other. To

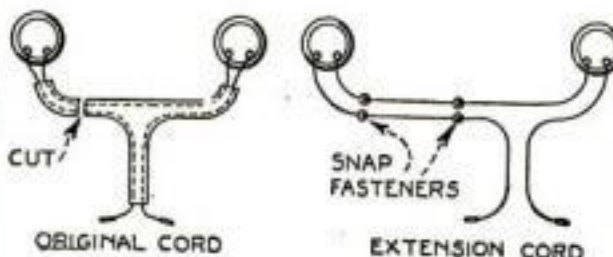


Diagram showing how the telephone cord is cut and two long extensions are inserted

each of the four wire ends thus produced is soldered one part of a large size snap fastener. The interlocking parts of the fasteners are soldered to the ends of two 10-ft. lengths of the new single cord, which can be purchased by the foot.

One must be careful not to mix up the connections. Usually a cord with marked insulation runs between the receivers, connecting them in a series, while a plain insulation is used on the cord from each receiver to the terminals. The new cords can be neatly sewed together in places with green silk thread to match the insulation.—KARL L. M.

Ohio.

Dental Laboratory



Learn to make Rubber Plates, Bridge Work, Crowns, Metal Base Dentures.

for Laboratories for each EXPERT of operating one!

60,000 DENTISTS NEED LABORATORY

Only a few hundred Laboratories in the U.S.—most of them in Chicago. Dentists can't afford mechanical jobs. They can't afford a Laboratory Expert at an hour, and they want better service than they can get now.

OPEN A LABORATORY your OWN!

Jow Wilk of Chicago started a couple of years ago ALONE. Today he employs 100 and his Laboratory is one of the biggest in the U. S. Boos of Chicago is reported to employ 125 men and to clear \$40,000 to \$50,000 a year. You can start your own Laboratory with as little as \$100 investment.

EARN While You LEARN!

Day students make all or part cost of course by part-time night work. Night students can find plenty of good jobs in Chicago to see them thru.

W. I. I. Help You!

Interesting Catalog FREE!

Catalog tells you how quickly and easily you can get ready, how hundreds of others have SUCCEEDED! Tells you how you learn in few months BY DOING ACTUAL LABORATORY JOBS under world's greatest Mechanical Dentist! Brings you FREE R. F. FARE offer and other big inducements. Write for free catalog today!

McCARRIE SCHOOL OF MECHANICAL DENTISTRY

Dept. 302, 34 and 36 W. Lake St., Chicago

McCarrie School of Mechanical Dentistry
Dept. 302, 34 and 36 W. Lake St., Chicago

Without obligation please send me your FREE R. F. FARE Offer and free catalog with complete information about how I may become a Dental Laboratory EXPERT.

Name.....
Address.....
St. No. or R. F. D.

Extra High Bench Is Convenient for Delicate Work

WHEN I straightened up one day to relieve my back while constructing a delicate piece of cabinet work, the idea of a high bench suddenly came to me. I built one at once and now do the majority of my small puttering jobs at it.

The bench is 3 ft. 9 in. high, just right for me to rest my elbows without bending. This is a wonderful help in steady-ing the hand while doing small, difficult work. The top is about 3 ft. square, which is large enough for such jobs as can be done on a bench of this height. I have also placed a foot rail about 12 in. from the floor.

—W. F. MESSENGER, Stillwater, N. Y.



Doing woodcarving at the high bench.

How to Make a Practice Mute for the Violin

THIS practice mute for a violin was constructed from my own design and has proved very satisfactory. With the mute in position the tones of a violin can hardly be heard in an adjoining room.

A metal tube is soldered on the top of an ordinary metal violin mute to take a plug, which is shown partially withdrawn.



Mute with heavy plug partly withdrawn

In this case the plug is a section of bar solder, but lead would be as suitable.

The plug must fit perfectly; any vibration causes an unpleasant quality of tone. I have found a slightly tapered construction of tube and plug

(1/16 in. smaller at one end) desirable, and it is well to wrap one thickness of soft paper around the plug.

The plug may be soldered in the tube or soldered directly to the top of the mute, if it is to be used for practice work only; but by making the plug removable, the mute may also be used when desired as an ordinary mute.—LESLIE H. PHINNEY, Springfield, Ill.

Fastening Picture-Frame Backs

USED steel phonograph needles are valuable for fastening the backs in picture frames, especially when the frames are small and delicately constructed. The needles will not split the wood and they can be pressed into place without hammering.—ALBERT KORTE, Bridgeport, Conn.

Build your own Radio Set!

—and save half the labor customarily involved.

The panels are completely drilled, and the parts are simply fastened with screws and nuts.

Any circuit desired may be employed. We have eight different types of panels.

The crystal black panel finish, together with the concave dials, lend a pleasing effect—the absence of knobs giving a clean, flush appearance.

You can build, or buy, a cabinet to suit your individual taste.

Illustrated catalog upon request

EISEMANN

EISEMANN MAGNETO CORPORATION
William N. Shaw, President
40 THIRTY-THIRD STREET, BROOKLYN, N.Y.

Learn to Mount Birds

Learn at home to mount birds, animals, game heads; tan furs, make rugs and robes. Complete lessons. Easily and quickly learned by men, boys and women.

FREE Write for Free Taxidermy Book. Tells all about it. Every sportsman, trapper and Nature lover should know this wonderful fascinating art. Save your trophies. Big profits. Success guaranteed. 75,000 graduates. Investigate. Write for Free Book.

Northwestern School of Taxidermy 1782 Elwood Bldg., Omaha, Neb.

FORD RUNS 57 MILES ON GALLON OF GASOLINE

A new automatic and self-regulating device has been invented by John A. Stransky, 2063 Fourth St., Pukwana, South Dakota, with which automobiles have made from 40 to 57 miles on a gallon of gasoline. It removes all carbon and prevents spark plug trouble and overheating. It can be installed by anyone in five minutes. Mr. Stransky wants agents and is willing to send a sample at his own risk. Write him today.—Adv.

60% of Market Price

Will Buy Diamonds Here

This 3/4-1/16 Ct. perfectly cut diamond, a snappy, blasing solitaire, at \$42.65 among bargains in our lists. See the many big amazing values some as low as \$50.00 per Carat, other higher per Carat bargains. This is our oldest largest Diamond-banking firm in all the world lends money on diamonds. Thousands of unpaid loans and other bargains. Must sell NOW.

Why Pay Full Prices

Costs Nothing To See Any Diamond sent for absolutely free examination at our risk. No obligation. No cost to you. Latest Listings—Unpaid Loans. Sent Free. Write Today. Describes Diamond Bargains in Detail, gives cash loan values guaranteed. Explains unlimited exchange privilege.

Jos. De Roy & Sons, 4717 De Roy Building
Only Opposite Post Office Pittsburgh, Pa.



This Ring \$42.65 3/4-1/16 Carat Perfectly Cut

AMAZING NEW FARM OFFER

The Canadian Pacific Railway offers you a Farm Home in Western Canada on a New Plan of Easy Payment. This makes it possible to own a farm home without taking all profits to meet payments and leaves a surplus for comforts and enjoyments.

PAYMENTS EXTENDED OVER 35 YEARS—FIRST YEAR FREE USE OF LAND

Under this plan all you pay down is 7% of the purchase price—One year's free use of the land without any interest. The balance of principal and interest will be amortized on an easy payment plan of 34 equal, annual payments which makes the second payment fall due two years after the purchase of the land, which is figured on the basis of 7% (including principal and interest) of the balance of the cost of the land. For example, on a purchase of 160 acres costing say, \$3,000, the down payment will be \$210 and the annual payments, commencing at the end of the second year, will be \$195.30. At the end of 35 years you will get clear title to the land—unless, of course, you wish to pay sooner, which is your privilege.

CANADA'S 1923 CROPS BEAT ALL RECORDS

In 1923 the wheat crop of Canada exceeded the 1922 crop by almost 100,000,000 bushels. In Alberta the average yield was 26.5 bushels per acre and there were many individual cases where yields of 50, 60, 75 and 80 bushels were returned. Other crops showed a corresponding increase over previous years with equally high yields. These enormous yields on moderate priced land even at average prices for farm products have placed many farmers on the high road to success.

NO TAXES ON IMPROVEMENTS YOU CANNOT BUY UNTIL YOU INVESTIGATE

Taxes are moderate and there are no taxes on livestock buildings, improvements, implements or personal effects. Good markets, modern schools, roads, churches, amusements make farm life in Western Canada desirable and attractive. Irrigated lands in Southern Alberta are also for sale upon the same amortization terms as other farm lands. Unfailing water supply, administered under Government direction. Full details on application.

M. E. THORNTON, SUPERINTENDENT OF COLONIZATION
Room 442, Canadian Pacific Railway Bldg., Calgary, Alberta



FREE SPORTING GOODS CATALOG

Write for our wholesale prices on football, basket ball and base ball, athletic goods. Free D & M rule book on all sports.

Wholesale Distributors of Athletic Goods.
AMERICAN SPORTING GOODS CO.
Jacksonville, Ill.

Clear Your Skin!

Your Skin Can Be Quickly Cleared of Pimples, Blackheads, Acne Eruptions on the face or body, Barbers Itch, Eczema, Enlarged Pores and Oily or Shiny Skin.

FREE Write today for my FREE BOOKLET, "A CLEAR-TONE SKIN," telling how I cured myself after being afflicted 15 years. \$1000 Cash says I can clear your skin of the above blemishes.
E. S. GIVENS, 153 Chemical Bldg., Kansas City, Mo.

BURN YOUR NAME ON TOOLS WITH ARKOGRAF

Protect your tools from theft. Write any name, engrave any design on metal with electricity like writing on paper with pen or pencil. Complete outfit \$3.00, prepaid anywhere. Interesting descriptive circulars free. Write to-day. Agents wanted.
Arkograph Pen Co., 481-A East Couch St., Portland, Oregon

World's Greatest BATTERY BARGAIN

FREE Written 2-Year Guarantee Your Proof of Performance
START NEW YEAR RIGHT

Thousands of Popular Science Monthly Readers will profit by this amazing offer. They will buy the famous 2-year guaranteed World Battery at the lowest price ever quoted. They will get their choice of a hydrometer and a "B" Battery or a nickel Auto Spotlite FREE. And they get the best battery built, with 2-year ironclad guarantee.

Compare These Prices
Five Per Cent Discount for Cash with Order

Automobile Prices	Radio Prices
6 Volt, 11 Plate - \$12.25	Special 2 Volt Storage Battery - \$5.00
Ford, Chev., Mitchell, Hup., Grant, Elgin, Velle, Saxon.	For W. D. 11 and W. D. 12 Tubes. Will run 200 hours on one charge. Rechargeable.
6 Volt, 13 Plate - \$14.00	Special 4 Volt Storage Battery - \$8.00
Overland, Buick, Reo, Paige, Hudson, Nash, Stude., Dorr.	For U. V. 199 Tubes. Same features as 2 Volt.
12 Volt, 7 Plate - \$17.00	6 Volt, 60 Amps. - \$8.50
Maxwell, Dodge, Regal, Frank., Briscoe and Crow.	6 Volt, 80 Amps. - 10.00
Kikhart.	6 Volt, 100 Amps. - 12.50
Give year and model of car	6 Volt, 120 Amps. - 14.50
	6 Volt, 140 Amps. - 16.00

SEND NO MONEY
You need not send a penny. Just clip this ad, and mail with your name and address. The battery you specify will be shipped to you the day your order is received. When the battery arrives, inspect it—read our 2-year guarantee before you pay one penny. Convince yourself you are protected from every angle—that the World Battery saves you 50 per cent. Get the "B" Battery and hydrometer, or Auto Spotlite FREE. Clip the ad, and send your order today.

WORLD BATTERY CO.
Dept. 7, 1219 So. Wabash Ave., Chicago, Ill.

Your Choice
FREE
Nickel Auto Spotlight
"B" Battery and Hydrometer



Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

OF THE drying oils used in compounding and diluting paint, linseed oil is the most important. Before being incorporated in varnishes and paints, it is usually boiled and almost always diluted with turpentine. This makes it dry more rapidly, and it therefore serves as a drier.

The best way of diluting paint is to add turpentine (spirits of turpentine will do). The addition of gasoline or petroleum, which is sometimes used, or benzol (benzene) is not to be recommended. They are just solvents and, having no body, they evaporate, while turpentine oxidizes to a resinous product, which aids in holding and covering the surface.



Putty of linseed oil and precipitated chalk

Five colors are required for mixing any ordinary shade of paint. These are black, white (zinc white or white lead), lemon yellow, carmine, and Prussian blue. Mixing a little black in the white gives a gray shade, although a trace of blue may be helpful in accentuating the gray. Blue and carmine give violet; yellow and blue, green; yellow and carmine, orange. In this way any bright or dull shade can be mixed together in a few moments and thinned with the turpentine and linseed-oil drier.

After use, clean paint brushes at once with plenty of soap and water. If the brush is hard, let it stand overnight in a thick soap solution and clean next morning.

If the brushes are rocklike, soften by placing them in a glass or porcelain vessel containing 1 lb. of sodium carbonate (about 25 cents worth) in 1½ qt. of water, which should be kept lukewarm for about a day. The softened brush can then be cleaned with soap and water. When it is necessary to keep a uniformly delicate shade, it is best to clean the brush further with benzol.

By boiling raw linseed oil (10 parts) with manganic peroxid (1 part) that has been thoroughly dried and placed in a bag in the oil, a good drier is obtained. It can be taken as a rule never to add too much drier to a paint. A teaspoonful or so is sufficient to a pint.

Not long ago I required a drier immediately and could not buy any because

(Continued on page 131)



AT YOUR DEALER'S COUNTER

Buy a good Head Set.

Good Head Sets must have Powerful Magnets.

Powerful magnets ensure sensitivity, great volume of sound and true tonal quality.

The power of Head Set magnets is easily tested at your dealer's counter.

Unscrew the cap on the ear piece. Place the thin circular diaphragm on the counter. Hold the ear piece above it and see how far the magnet will pick up the diaphragm.

The farther the pick up, the more powerful the magnet, and the better the Head Set.

A Stromberg-Carlson Head Set will pick up its diaphragm at least one-fourth of an inch. Will yours?

Stromberg-Carlson

Telephone Mfg. Co.
ROCHESTER,
N. Y.



Home Workshop Chemistry

(Continued from page 130)

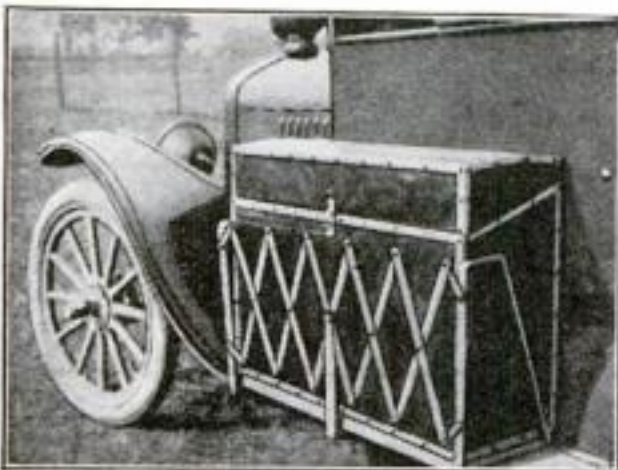
the day was a holiday. I placed less than half a teaspoonful of manganese borate, which I happened to have, in a pint of linseed oil, and brought the whole to a slight simmer for a quarter of an hour. When it was cool, I had a drier that would dry in 24 hours. It proved also to be an excellent and practically colorless varnish.

A paint made up with white lead requires a slight amount of drier, but a drier is not added when red lead is used as a color, for red lead imparts drying properties to linseed oil. When a non-tacky surface is essential, as for floors and chairs, a drier made with a lead preparation, such as red lead or lead acetate is to be preferred over the manganese type.

Raw linseed oil, which dries much more slowly than boiled oil, may be mixed with precipitated chalk and kneaded to a dough to form a putty that remains soft for quite a time.

Runningboard Trunk for Long Auto Trips

FOR long auto trips, this runningboard trunk has proved most useful. It is 10 by 18 by 30 in., made of 1/2-in. white pine and covered with medium-weight imitation leather. The lid is 6 in. deep in front and 2 in. deep in back. The corners and edges are bound with zinc cut in strips 3/4 in. wide and fastened with brass-



This imitation leather-covered auto trunk fits the luggage carrier on runningboard

headed upholstery nails. One or two suitcase fasteners hold the cover shut, and a lock and handles can be added, if it is desired.

While the trunk might be made larger, it is commodious enough for average purposes and has the advantage of fitting into a standard runningboard luggage carrier. —HAROLD JACKSON, Kankakee, Ill.

Improving a Cheap Paintbrush by Setting Hairs in Varnish

AT TIMES, when a good paintbrush is not at hand and the work to be done does not warrant the purchase of one, a cheap brush may be made to serve by setting the hairs in varnish.

Dip the brush so as to submerge all the hair and work out the surplus varnish while holding the handle down. Then let the brush dry for 24 hours, handle down and hair up. A wire holder can be made in half a minute to hold the brush in this position while the varnish is drying. —L. W. FEAGIN.



Super-service

Wide-awake radio fans refuse to miss a good program because of storage battery weakness. For super-service they keep the battery fully charged from the house current with a Tungar. Likewise they use Tungar to charge the auto battery at home. The result is longer battery life and more "pep" — plus convenience.

In homes with electricity Tungar recharges the run-down radio or auto battery over night at a saving.

Sold by Electrical, Auto-accessory and Radio dealers.



The home completely wired is ready for every convenience and comfort that Electricity can furnish.

The book — "The Home of a Hundred Comforts" tells how to plan for a completely wired home. Thousands have sent for it. Write for your free copy.

Address Section P. 2
Merchandise Department
General Electric Company
Bridgeport, Conn.



Tungar

BATTERY CHARGER

Tungar operates on alternating current. Two sizes \$18.00 and \$28.00 (60 cycle). East of the Rockies.

GENERAL ELECTRIC

A \$500 Cash Prize

is offered for the
BEST SECOND VERSE TO "REMEMBER"

Those wishing to compete may receive a free copy of this song and rules of contest by addressing
EQUITABLE MUSIC CORPORATION
476 State Theatre, N. Y. C.

\$33 FARM ENGINES

Save \$21 ordering direct from your factory says W. Price, Ind. You will save on our reliable engines. Built to do hard, heavy work. Kerosene, Gasoline. Easy to start—no crank. Sizes 1 1/4 to 22 H.P. 3 Months Trial.

Cash, Easy Terms; 10-Year Guarantee.
Free Book—"How to Know Better Engines"
Write today. **THE OTTAWA MFG. CO.**
1951-Z King Street, OTTAWA, KANSAS
Desk 1951-Z Magee Bldg., PITTSBURGH, PA.

MAKE BIG MONEY

Put Yourself on Easy Street

Learn the trade and master the art of making beautiful sparkling, highly polished, marble, granite, agate, and turquoise, faced brick, building blocks, tile, table tops, monuments and kindred products from common Portland cement at one tenth cost. For full particulars address, Master Cement Worker of the World, 433 W. 46th St., Los Angeles, Calif.

LAW

STUDY AT HOME

Become a lawyer. Legally trained men win high positions and big success in business and public life. Greater opportunities now than ever before. Be independent—be a leader. Lawyers earn \$3,000 to \$10,000 Annually.

We guide you step by step. You can train at home during spare time. Let us send you records and letters from LaSalle students admitted to the bar in various states. Degree of LL. B. conferred. Thousands of successful students enrolled. Low cost, easy terms. We furnish all text material, including fourteen-volume Law Library. Get our valuable 120-page "Law Guide" and "Evidence" books FREE. Send for them—NOW.

LaSalle Extension University, Dept. 253-L, Chicago



"Send for Andrews he knows—!"

"Seems to me that every time a tough problem comes up around here we always send for Andrews."

"Do you know why? It's because he doesn't guess at a thing—he knows! He studies those I. C. S. textbooks every chance he gets, and I want to tell you it has made him a valuable man for this firm."

"This is the last time I'm going to 'send for Andrews.' For when he comes in to-day, he's going to stay in. From now on he's going to sit right in this office as my assistant. I wish I had more men like him."

How do you stand in your organization? Are you a guesser? Or do you know? Make up your mind to-day, that you, too, are going to get the special training that you must have to get a better job and a larger salary.

One hour a day, spent with the International Correspondence Schools, in the quiet of your own home, will prepare you for the position you want in the work you like best.

Mail the Coupon To-day!

INTERNATIONAL CORRESPONDENCE SCHOOLS Box 7673-C, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X:

BUSINESS TRAINING COURSES

- | | |
|--|---|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Advertising |
| <input type="checkbox"/> Personnel Organization | <input type="checkbox"/> Better Letters |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Show Card Lettering |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Banking Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accountancy (including C.P.A.) | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Private Secretary | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Spanish <input type="checkbox"/> French | <input type="checkbox"/> Illustrating |

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|---|--|
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Blue Print Reading |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
| <input type="checkbox"/> Machine Shop Practices | <input type="checkbox"/> Concrete Builder |
| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Chemistry <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Airplane Engines |
| <input type="checkbox"/> Metallurgy <input type="checkbox"/> Mining | <input type="checkbox"/> Agriculture and Poultry |
| <input type="checkbox"/> Steam Engineering <input type="checkbox"/> Radio | <input type="checkbox"/> Mathematics |

Name.....
Street.....
Address.....
City..... State.....

Occupation.....
Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

The Vest Pocket BOOKKEEPER

A simple and concise method of practical bookkeeping, with short cuts in figures and complete instructions for the correct keeping of books of accounts. A working model adapted to the novice and business man, by F. M. Payne; 160 pages, size 3 x 6 inches, artistic cover, \$1.00 postpaid.

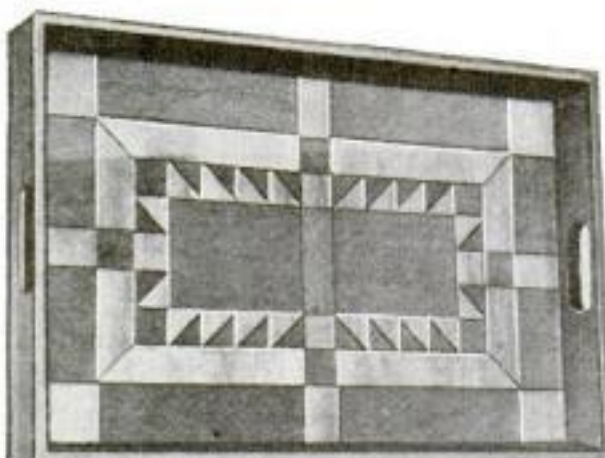
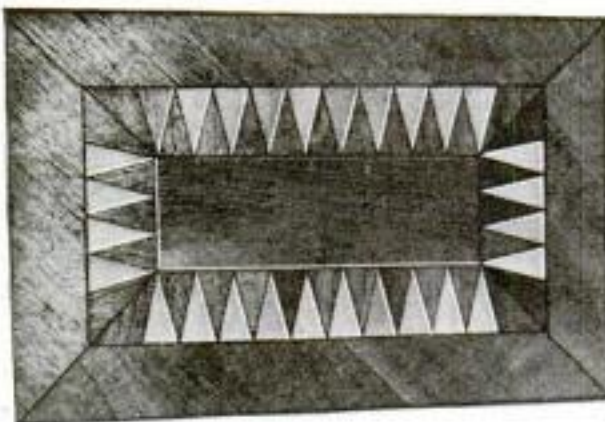
POPULAR SCIENCE MONTHLY
225 WEST 39th St., NEW YORK

Inlaid Serving Trays Made with Cigar-Box Wood

By M. W. Lowry

AN ATTRACTIVE serving tray with an inlaid effect can be made by sawing the wood of cigar boxes into small pieces and gluing them on a thin base to form a pattern.

Tear apart several cigar boxes and remove the paper covering by soaking and scraping. It will be found that some boxes are of cedar or similar wood having a beautiful grain, while others are poplar or other white or nearly white wood with very little grain. Sort the pieces of wood



An "inlaid" bottom before framing (above) and a tray with another pattern (below)

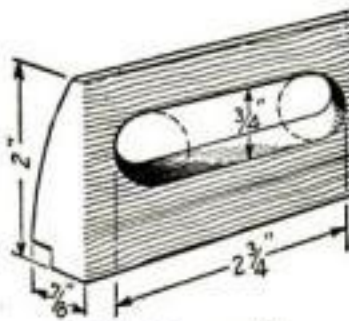
according to color and grain, and dry thoroughly.

The usual size of these trays is 11 by 17 in. The pattern should be worked out to conform to these proportions. A good way to start is with a panel of dark wood in the center 3 by 9 in., which will leave 4 in. on all sides to be filled in. The design can be worked out with alternating light and dark woods in squares, triangles, rectangles, and other shapes, according to the designer's fancy.

A few sheets of cross-section paper are a great aid in laying out the pattern. Let the large squares represent square inches and fill in by shading the portions that are to be dark wood. The direction of the grain can also be indicated, and a good working plan made. When one gets started, numerous patterns suggest themselves.

For the base on which to glue the pieces, select three-ply veneer or a piece of thick, heavy pasteboard or wallboard about 1/4 in. thick. This should be left a little larger

(Continued on page 133)



Detail of tray molding and handles



17c
a Day
Pays for
this
Beautiful
Rocker

Over 1000 other Cozy Home Furnishings. Latest styles. Just what you need now. Save big money at our low Factory-to-Family prices. Pay as little as \$3 down; up to a year and a half to pay balance. Get all your Furnishings at once—pay as you use. Thousands buying this new way.

Big Catalog FREE

New Spring "Larkin Book of Better Homes." Shows everything for parlor, porch, dining-room, bedroom, kitchen. Bargain Prices on famous Symphonola Phonographs. Also Symphonola Pianos, Player-Pianos in genuine Mahogany, Walnut, Fumed Oak. Free trial. Up to 4 years to pay. Satisfaction or money back. Check below article interested in.



- ☐ Home Furnishings
- ☐ Pianos or Players
- ☐ Phonographs

Cut out this adv.—write TO-DAY for FREE Book.

Larkin Co. Inc.
Dept. 240, BUFFALO, N. Y.
Peoria, Ill. Chicago, Ill.

SEND NO MONEY 2 GENUINE DIAMONDS ⁴/₁₀₀ Each

(Cut Stones—No Chips)

Solid Gold
\$25

14 Kt. White
Gold Top, Gold
Initial or Em-
blem Inlaid in



Genuine Hope Ruby This Registered Trade-Mark guarantees you genuine diamonds

CAN ALSO BE HAD IN GENUINE BLACK ONYX
Can be had in all initials (Old English); also in all lodge emblems.



Send size of finger and ring will be sent for inspection.

Buffalo Jewelry Mfg. Co., "The Mail-Order House"
Dept. A, Brisbane Bldg., Buffalo, N. Y.

Makes \$75.00 a Week and up

Make \$75.00 a week and up, selling our fine made-to-measure, all-wool suits at \$31.50 retail, direct to wearer. Biggest values—positively sell on sight. Biggest commissions paid in advance. We attend to delivery and collections. 6 x 9 swatch samples—over 100 styles all one price—furnished FREE. Write at once.

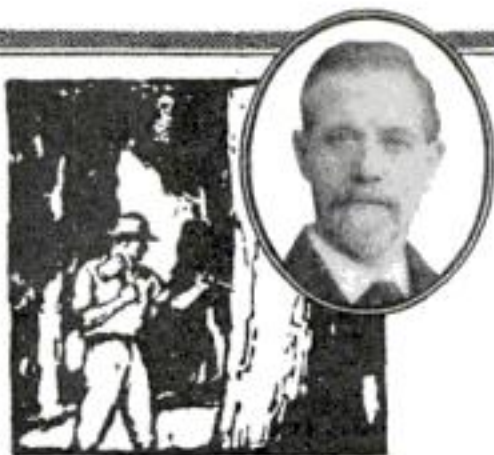
W. Z. GIBSON, Inc. Merchant Tailor
161 W. Harrison St., Dept. B-25 CHICAGO



BLANK CARTRIDGE PISTOL

Protection against Burglars, Tramps, & Dogs
PRICES 50c. \$1.00
POST-PAID
Well made and effective. Modelled on latest type of revolver. Apparent as a real gun. When loaded it may be as effective as a real revolver without danger to life. It takes standard .22 Cal. Blank Cartridges obtainable everywhere. Price 50c. Superior quality \$1.00 postpaid. Blank Cartridges, by express, 50c per 100.
Johnson Smith & Co., Dept. 56, Racine, Wis.





John Davey's organization needs young men

John Davey's organization, The Davey Tree Expert Co., Inc., has a limited number of openings for ambitious young men between 20 and 30 years of age, single men preferred. The opportunity is unusual, offering good pay at the start, permanent employment in the Davey organization, and thorough scientific training in the profession of Tree Surgery. Advancement rapid, according to merit. The work is fascinating, offers chance to travel extensively, and association with fine fellows. Only clean, red-blooded young Americans, lovers of the outdoors, need apply. Write, giving full information to The Davey Tree Expert Co., Inc., 55 City Bank Bldg., Kent, Ohio.

21 Jewel Burlington



Only \$1.00 Down

The 21-Jewel Burlington is sold to you at a very low price and on the very special terms of \$1.00 down—free examination—small monthly payments after acceptance. Send today for information.

Free Book Send for the most complete watch book ever produced. 100 designs and engravings beautifully illustrated in colors. Write for it today. It is free. A letter or a postcard will do.

Burlington Watch Co. 19th St. & Marshall Blvd. Dept. 13-62 Chicago

Big Value for 10 Cts.



6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Joke Book; 1 Book on Love; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Base Ball Book, gives rules for games; 1 Toy Maker Book, Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 3 Puzzles; 12 Games; 30 Verses for Autograph Albums. All the above by mail for 10 cts. and 2 cts. postage.

ROYAL SALES CO., Desk 161, South Norwalk, Conn.

MAKE MONEY AT HOME

YOU CAN make \$1 to \$2 an hour writing show cards at home in your spare time. Quickly and easily learned by our new simple method. No canvassing or soliciting. We show you how, guarantee you work at home no matter where you live and pay you cash each week. Full particulars and booklet free. Write to-day.
AMERICAN SHOW CARD SYSTEM LTD.
Authorized and Fully Paid Capital, \$1,000,000
206 Adams Bldg. Toronto, Canada

Inlaid Serving Trays

(Continued from page 132)

than the tray is to be and should be tacked around the edges to a wide board, so that it will be held straight until the bottom is finished.

When the selected wood has been cleaned and dried, it is cut with a miter box and fine backsaw into pieces of the desired shapes and sizes. The edges are smoothed off with fine sandpaper. The pieces are then glued to the base, care being taken that they fit quite closely, with good joints. They must be braced from the sides till the glue sets or they will creep apart.

Where a line of small pieces are put on next to a large piece, it is best to put on the small ones first, as far as possible, as it is easier to fit the one large piece than the many small ones.

When the glue is dry, dress off the surface with a sharp plane until smooth. Finish with fine sandpaper, and oil or wax the surface. Wax brings out the grain beautifully and gives the wood a very rich appearance. The edges are then trimmed to the correct size.

Tray Frame and Handles

The framing can be done by any picture-frame maker, who usually will have molding suitable for this purpose. If it is desired to have the whole tray handmade, the molding can be made from birch, maple, gum, mahogany, or walnut strips 2 in. wide and $\frac{3}{4}$ in. thick. Cut a rabbet along one edge to receive the bottom of the tray and bevel and round the inside edges. Leave outer edges straight.

The handles are cut in the end pieces by boring two $\frac{3}{4}$ -in. holes $2\frac{3}{4}$ in. apart from outside to outside and chiseling out the wood between. Put the frame together and varnish with mahogany or walnut varnish stain, finishing with a coat of clear hard varnish. Then insert the bottom under a piece of glass, fastening it in with tacks.

The under side of the whole tray should be covered with felt.

FEATURES FOR MARCH

How to make—

A neutrodyne radio receiving set. In order to obtain the best and clearest article yet written on assembling a neutrodyne set, POPULAR SCIENCE MONTHLY turned to Prof. Louis A. Hazeltine, the inventor. He has lent the services of John F. Dreyer, Jr., Chief Engineer of the Hazeltine Research Corporation, for the preparation of this important feature.

A Chinese game table. Now that "punging" and "chowing" have become one of the most popular indoor amusements, George F. Kaercher has designed an especially convenient and attractive table for playing the game and it can be made at relatively small cost.

New furniture from old.

A built-in buffet.

A combination bench saw, boring and molding machine.

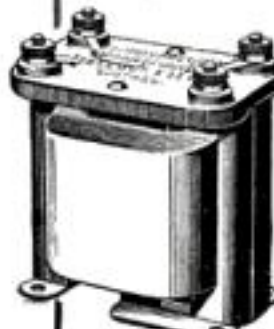
Also there will be, as usual, articles in practically every field of interest to home workers.

Your RADIO Set

will be the talk of all your friends if built with Kellogg radio equipment. Volume, clarity and satisfaction will reward your efforts.



Kellogg Rheostat
6 or 25 ohms
\$1.50



Kellogg Transformer
4 to 1 or $3\frac{1}{2}$ to 1
\$4.50



Kellogg Variocoupler
With Coil, \$13.00



Kellogg 43 Plate Variable Condenser
With Vernier
\$8.75



(Trade Mark)

Built and Guaranteed by
**KELLOGG SWITCHBOARD
& SUPPLY COMPANY**
CHICAGO, ILL.

Every Kellogg radio part is accurately and carefully built for its specific purpose.

Every piece of metal, insulation, etc., that goes into the making of the completed parts is the best that money can buy.

The popularity of Kellogg at the Chicago Radio Show proves that the demand is for a high quality product in radio as well as in everything else.

Demand Kellogg and know you are getting the best—experimenting with inferior apparatus is expensive and discouraging.

If your dealer cannot furnish **KELLOGG** write or wire us his name and address.

Your Choice 75c a Week



No matter what your occupation, one of the home study sets listed below will quickly fit you for a better job and bigger pay. Any set you select will be sent for seven days' examination, and if you decide to buy you may pay the rock bottom price at the rate of **only 75c a week**. But you must act now! The rising cost of paper and binding materials won't permit us to continue the present low prices much longer.

These books are the work of recognized authorities. They are written in plain, easily understood language, by recognized authorities, and contain hundreds of photographs, diagrams, tables, etc., that make difficult points as simple as A-B-C. Handsomely and durably bound in half or full morocco leather (except as noted), and stamped in gold.

Pay-Raising Books At Greatly Reduced Prices

Business Management, 8 vol., 2500 pages, 1000 pictures. Was \$52.50. Now \$29.80
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was \$37.50. Now 19.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was \$67.50. Now 34.80
Electrical Engineering, 8 volumes, 3800 pages, 2600 pictures. Was \$60.00. Now 29.80
Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures. Was \$45.00. Now 21.80
Machine Shop Practice, 6 volumes, 2300 pages, 2500 pictures. Was \$45.00. Now 21.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was \$52.50. Now 24.80
Law and Practice (with reading course), 13 volumes, 6000 pages, illustrated. Was \$97.50. Now 49.80
Fire Prevention and Insurance, 4 vols., 1500 pages, 600 pictures. Was \$30.00. Now 14.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was \$30.00. Now 14.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures. Was \$30.00. Now 14.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blue prints, etc. Was \$30.00. Now 14.80

Send No Money Shipped for 7 days' Trial

Yes, we'll gladly ship any set right to your home or office upon your simple request. Pay only shipping charges when the books arrive. Don't send a penny until after you have used them seven days, then remit only \$2.80 or return them at our expense. Pay balance at the rate of \$3.00 a month—**75c a week**. Act now—while these splendid books are being offered at 20% to 50% less than regular prices. This offer is open to every person within the boundaries of the U. S. and Canada. Grasp your opportunity—fill in and mail the coupon now.

American Technical Society, Dept. X-220, Chicago

American Technical Society, Dept. X-220, Chicago, U. S. A.

Please send me set of.....

for 7 days' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send \$2.80 within 7 days and \$3.00 each month, until I have paid the special price of.....
 If I decide not to keep the books, I will notify you at once and hold them subject to your order. Title not to pass to me until the set is fully paid for.

Name.....

Address.....

Employed by.....



Keeping the Home Shipshape

How to do the odd jobs that save time, temper, and money



Doorbell Transformers

TO INSTALL a transformer for operating a doorbell with electric current from the lighting circuit, first determine the voltage of the line (usually 110 or 220 volts). Then buy a transformer that is suited to that voltage.

The voltage on the secondary or doorbell side of the transformer may be six or 12 volts or two or three different voltages. If the latter type is obtained, it will be possible to draw one voltage for one purpose and another for another purpose—as 12 volts for the doorbell and 24 for a 24-volt motor.

The rubber-covered wires leading from the transformer shown in Fig. 1 go to the lighting line. The binding posts on the top are for the bell connections. This photo-diagram shows a standard hook-up of transformer, bell and button.

To conform to the requirements of the Board of Underwriters, the following points must be observed and carried out in making the installation:

All joints or splices on the line side must be soldered after the wires have been scraped, then wrapped with rubber tape and the whole covered with friction tape.

The transformer must be placed on a sheet of asbestos of approximately three times the area of the base of the transformer and, while not absolutely necessary, the wires leading to the bell should be rubber-covered.

When making connections (this applies

to all connections of a similar sort) the wires should be cut longer than necessary and the extra amount wrapped several times about a pencil to form a coil. Then, if a connection should break, there still will be enough wire to reconnect without making another splice or using new wire.

One of the best places for the transformer is on the under side of the first-story floor, if the home has a basement. Since it does not require attention, it is out of the way there and when properly installed is perfectly safe and foolproof.

Many installations, however, are made in the fuse box when the box is of sufficient size for the purpose. How a small trans-

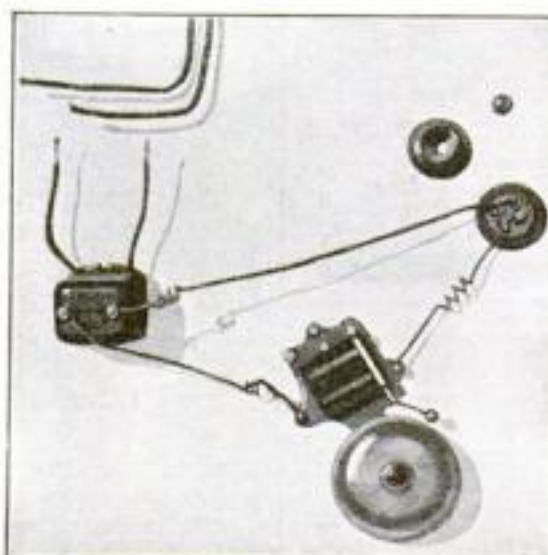


Fig. 1. Photo-diagram of the doorbell circuit using a transformer instead of batteries



Fig. 2. Transformer in asbestos-lined can

former, such as the one just described, can be installed in a box of its own is indicated in Fig. 2. The coffee can, which has a tight cover, is fastened to the wall with screws. The inside is lined with asbestos and porcelain tubes, or bushings, are used where the wires pass through the tin, at least for the lighting circuit.

\$50 FOR SHIPSHAPE HOME IDEAS

HOW do you keep your home shipshape?

For the best letters containing practical, novel, and ingenious ideas on this subject, POPULAR SCIENCE MONTHLY will give a first prize of \$25, a second prize of \$15, and a third prize of \$10, and will purchase at space rates as many other contributions as are available for use in the Shipshape Home columns.

Take for your title, "How I Keep My Home Shipshape." Tell your own experience—what you actually do in the way of woodworking, painting, and varnishing, wallpapering, plumbing, and the like. Don't simply catalog a number of odd jobs. Pick out one or two of your own ideas that have been particularly successful in reducing the upkeep cost

of your house or apartment and describe them in such a way that other readers will be able to make profitable use of the same methods. This is a contest intended primarily to help the other fellow.

Keep your letter short—not more than 400 words. Inclose photographs or pencil sketches, if possible, to illustrate the ideas or methods.

The competition will close February 20. The winning letters will appear in the June issue. The contest will be judged by the Board of Editors and their decision will be final. Unavailable letters will be returned if accompanied by stamped and self-addressed envelopes.

Address Shipshape Home Editor, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

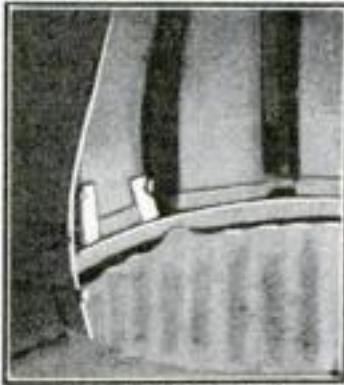
The Shipshape Home

(Continued from page 134)

Repairing Furnaces

STOVES and furnaces frequently develop cracks and these sooner or later involve costly and troublesome replacements. This expense often may be avoided or indefinitely postponed by stopping the progress of the crack and repairing the break as soon as they appear.

The photograph shows part of the interior of a hot-air furnace with cast-iron air ducts resting on the firebox. After a few years of service, the ducts developed five cracks at their junction with the firebox, with the result that coal-gas escaped into the rooms above through the air pipes.



Two patches inside hot-air furnace

The progress of the cracks was arrested by drilling a small hole just a trifle beyond the limit of each one and in the line of its path. These holes were tapped for $\frac{1}{4}$ -in. stove bolts, which were used to hold pieces of heavy galvanized iron over the crack. Furnace cement under the patches helped to make them gastight.

The furnace has survived two winters' usage since being repaired and is in good shape.—O. S. MARSHALL, Springfield, Vt.

Planes and Planing

SKILL in the use of both wood and iron planes has to be acquired. A great many men earning their living with woodworking tools cannot clean up a cross-grained, brittle piece of wood in a thoroughly workmanlike manner.

Tearing the wood is perhaps the most common fault of the home worker. This means that rough places are left on the surface, especially around knots. To remedy this the cutting blade must be kept sharp. It must have the right taper when ground in the first place and the back iron must fit down tightly and snug. For fine work the back iron should be close to the edge of the blade. The wedge or cap iron must fit tightly and hold the blade firmly and solidly.

With a sharp, properly adjusted plane set fine, any one should be able, with ordinary care, to clean up cross-grained wood.

When planing, pressure should be put upon the front of the plane with the left hand. The right hand is used only for pushing, except at the very end of the board, when the pressure is transferred to the rear handle so that the wood will not be tapered down. If a plane were heavy enough, it only would need to be pushed, but as they usually are light, some pressure is required, and practice soon teaches how much this should be.

If, after taking a few strokes, the plane chokes up, it will be because the above precautions have not been taken or be-

(Continued on page 136)

PATENTS

TRADE MARKS COPYRIGHTS

PROTECT YOUR IDEAS

ANY NEW article, machine, design or improvement thereof, or any new combination of parts or improvements in any known article which increases its efficiency or usefulness, **may be patented**, if it involves invention.

If You Have Any New Ideas

which you feel are useful, practical and novel, **take prompt action to protect your rights**. If you have invented any new machine, or new combination of parts, or improvement, or any new design or process, **SEND DRAWING, MODEL OR DESCRIPTION** of it for information as to procedure to secure protection.

Write Today for Blank Form "Record of Invention"

USE THE COUPON attached, and immediately upon its receipt I shall send you this form to be returned to me with drawing, description or model of your idea; promptly upon receiving your idea I shall write you fully as to procedure and costs.



DRAFTING and SPECIFICATION ROOM of CLARENCE A. O'BRIEN, Registered Patent Attorney, Washington, D. C.

No Charge for Above Information

All communications are held in strict confidence. My personal, careful and thorough attention is given to each case. I offer you efficient, reliable and prompt service—based upon practical experience. **Highest references.**

WRITE TODAY for free book "How to Obtain a Patent." This book will give you valuable information, and it may save you much time and effort. **Send for it NOW.**

My practice is devoted **exclusively** to United States and Foreign Patents and Trade Marks. Write me freely, frankly and with full confidence; it is very probable that I can help you. **Write TODAY.**

CLARENCE A. O'BRIEN

REGISTERED PATENT ATTORNEY

MEMBER OF THE BAR OF

SUPREME COURT OF UNITED STATES, COURT OF APPEALS DISTRICT OF COLUMBIA,
SUPREME COURT DISTRICT OF COLUMBIA, UNITED STATES COURT OF CLAIMS,
Practice Confined to Patents and Trade Marks

88-B Security Savings & Com'l Bank Bldg., directly across street from U. S. Patent Office, Washington, D. C.

CLARENCE A. O'BRIEN, Registered Patent Attorney, Washington, D. C.

88-B Security Savings & Com'l Bank Bldg., directly across street from U. S. Patent Office.

Please send me your free booklet "How to Obtain a Patent" and blank form "Record of Invention" without any obligation on my part.

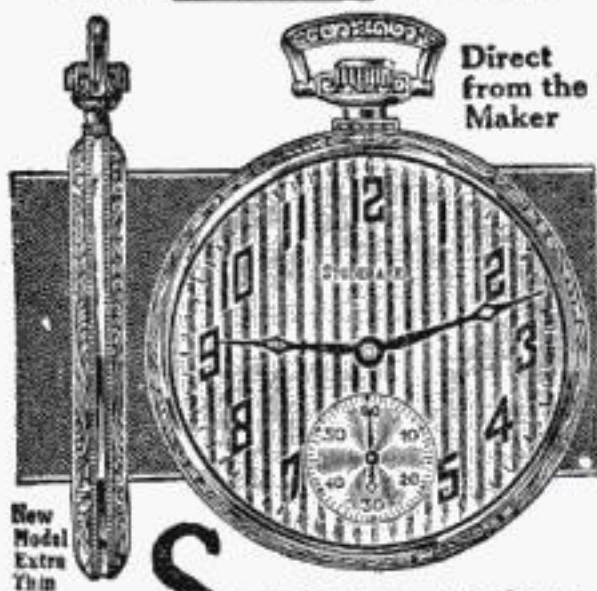
NAME.....

ADDRESS.....

(Write clearly)

HOW
TO
OBTAIN
A
PATENT

21 Jewel ~ Extra thin STUDEBAKER The Insured Watch



New Model Extra Thin

SENT FOR \$1.00 DOWN!

Only \$1.00! The balance in easy monthly payments. You get the famous Studebaker 21 Jewel Watch—Insured for a lifetime; a choice of 54 new Art Beauty Cases; 8 adjustments, including heat, cold, isochronism and 5 positions—direct from the maker at lowest prices ever named on equal quality. Write today for FREE BOOK of Advance Watch Styles.

Fine Chain FREE!

For a limited time we are giving away FREE with every Studebaker Watch a beautiful pattern Studebaker Watch Chain. Write now while offer lasts.

Mail Coupon for FREE Book of Advance Watch Styles

Send at once and get a copy of this book—FREE! See the newest, beautiful, advance styles in Studebaker Art Beauty Cases and Dials. Read how you can buy a 21 Jewel Studebaker Insured Watch direct from the maker—save big money—and pay for it on easy monthly payments.

Write! for our free book. It will post you on watch styles and watch values. Send coupon at once. Get Free chain offer today while it lasts.

Studebaker Watch Co.
Dept. 232 South Bend, Ind.



STUDEBAKER WATCH CO.
Dept. 232, South Bend, Indiana

Please send me your Free Book of Advance Watch Styles and particulars of your \$1.00 down offer.

Name

Address

City.....State.....

INVENTORS

who desire largest profits know and heed certain simple but vital facts before applying for Patents. Our book Patent-Sense gives those facts; free. Write Lacey & Lacey, 648 F St., Washington, D. C. ESTABLISHED 1899.

Superior Automobile Trouble Light

Only \$1.00 postpaid or C. O. D. if you wish.

Made of the highest grade materials, furnished in either single or double contact, complete with 10 ft. cord, 2 c.p. bulb, guard and socket. Order yours today.

INSTITUTE MFG. CO., Dept. 302,
311 Main St., Worcester, Mass.



The Shipshape Home

(Continued from page 135)

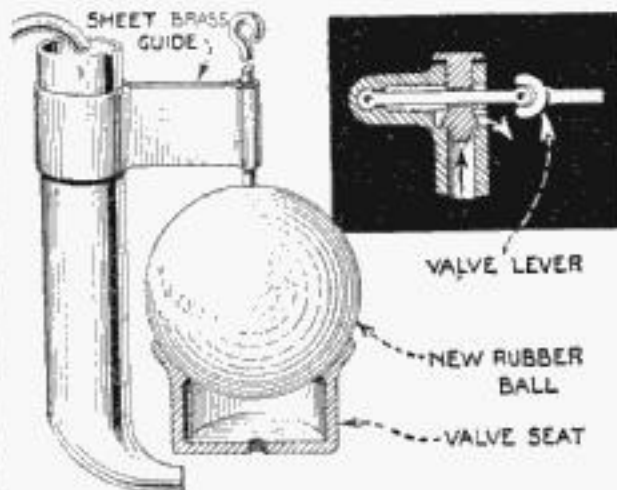
cause some imperfection in the mouth of the plane holds the shaving instead of allowing it to curl out easily. By careful observation the cause often may be found and remedied.

If you find slight marks or lines on the work, it will be because the cutting iron did not have the corners slightly rounded when sharpened. This always should be done.—A. E. E.

Repairing Flush Tanks

PLUMBING repair bills often can be avoided if the home worker will take the time and trouble to do the work himself. Recently our plumber condemned the flush tank in our bathroom and said that a new one would have to be installed at a cost of from \$15 to \$20. I was convinced that I could make the old tank work practically as well as new with about an hour's work and 10 or 15 cents expense.

Our ball valve was of the old type with rubber collars that continually stretched and let water leak through. By making



Two simple repairs to a flush tank that saved a \$15 or \$20 plumbing bill

the sheet-brass guide shown, I was able to substitute a rubber ball of the standard type.

Another difficulty was that the float would not always act certainly, the plumber's diagnosis being that the valve parts were so worn out as to be useless. The difficulty really was that the valve lever jammed against the socket of the float lever when the float had reached a certain point while rising. This was remedied quickly with a round file, so that there was ample play between the two levers. The parts were not worn out at all and the flush is now good for a lifetime's usage.—O. S. M.

Cleaning Traps

A COILSPRING about 2 ft. long and 1/4 in. in diameter is useful in cleaning the clogged trap of a sink, lavatory, or bathtub. Pull out one end of the spring until it looks like a corkscrew, and make a loop in the other end large enough so that a wooden rod or peg will slip through it. Then use the spring as an auger and screw it into the trap through the clean-out opening. You can fish almost anything out of the pipes by this means, and it will sometimes save a plumber's bill.—L. W. FEAGIN, Long Beach, Cal.



Fits Anywhere

THE same range of reception for which you now require a 100 foot or longer aerial—indefinitely improved upon by the Warren Radio Loop that fits into a coat pocket. Interference eliminated. Selects and tunes with remarkable ease and accuracy. All enclosed by Bakelite shields. Four compact sizes for every purpose. The best known—the best liked.

Write for the name of the nearest Warren dealer and Bulletin U-102

A TYPE FOR EVERY SET

Type-A-737 (300-700 meters) 6 inches square—non-directional	\$10
Type-A-7236 (175-1500 meters) 6 inches square—non-directional	\$12
Type-B-2537 (300-700 meters) 18 inches square—directional	\$20
Type-BL-2520 (200-18,000 meters) with honeycomb coil mounting, 18 inches square—directional	\$25

Send for Bulletin U-102

V-DE-CO RADIO MFG. CO. Dept. O, Asbury Park, N. J.

PATENTS

To the Man With an Idea

I offer a most comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
Patent Lawyer

6 Owen Building, Washington, D.C.
2276-D Woolworth Building
New York City

Cheapest Way to Go

to work or school and recreation is on a **Ranger** bicycle. Choice of 44 styles and sizes. 30 Days' Free Trial. Express prepaid.

12 Months to Pay if desired. Saved time and carfare easily meets the small payments.

Parts, equipment—at half usual prices. Send no money. Write for our remarkable factory prices and marvelous terms.

Mead Cycle Company
Dept. F in Chicago



BUCHSTEIN'S FIBRE LIMB

soothing to your stump—strong, cool, neat, light, Easy payments.



Guaranteed 5 Years
Send for Catalog Today

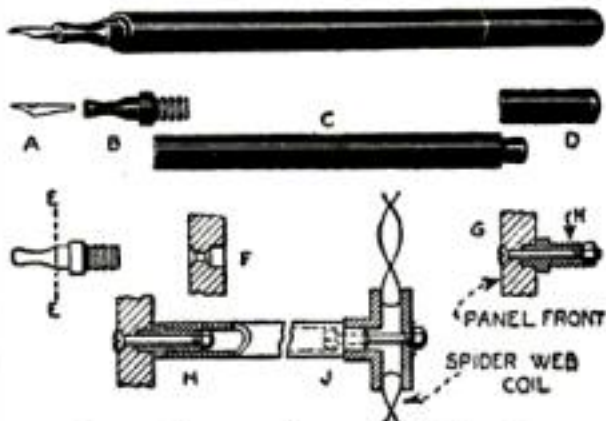
P. BUCHSTEIN CO., 610-3rd Ave., So. Minneapolis, Minn.

Braces for all deformities.

Old Fountain Pen Barrel Supports Spider-Web Coil

A NEAT, serviceable, well-insulated support for a spider-web coil can be made from a discarded fountain pen. The pen and cap parts A and D are discarded. The penholder B is cut off as shown at line E-E.

The detail F shows how the 5/16-in. panel is drilled. The holes will have to be shallower if the panel is less than 5/16



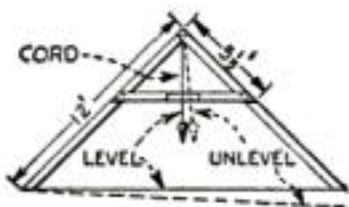
Fastened to a radio panel, the barrel of an old pen forms the coil support

in. thick. Detail G indicates how the pen is bolted in place with a French oval head machine screw. Care should be taken to file off the corners of the nut so that they will come slightly below the root diameter of the threads H. This is so that the nut will not interfere with screwing on part C. The detail J suggests one coil arrangement, which may be modified to suit the inductance to be mounted. The type of coil used by the author is a self-supporting Reinartz inductance.—FRANK W. HARTH.

Plumb-Bob Level Aids in Grading and Ditching

FOR laying out ditches, terraces, fence rows, and the like, and measuring short distances, the level illustrated serves very well and can be quickly and cheaply made.

The device is like a huge fixed divider or compass, with two 12-ft. legs made of straight and strong wooden strips. These are fastened exactly at right angles to each other and braced by a crossbar.



How the level is made and used

A plumb-bob hangs from the juncture of the legs, as indicated and the cord swings opposite a scale marked for a few inches on both sides of the center of the cross arm. These graduation marks enable one to give a ditch, terrace, or row a certain amount of fall by moving one of the instrument legs to higher or lower ground until the cord hangs directly in front of the desired mark.

When it is necessary to measure short distances or lay off fence rows, the bob should be removed. Then hold the level in both hands and swing it so as to describe a series of semicircles, as in stepping off a line with dividers, but be careful, of course, to go straight. Only approximate results can be obtained this way, but they are accurate enough for ordinary farm purposes.—B. KENNEDY, McCool, Miss.

PATENTS TRADE-MARKS AND COPYRIGHTS

OUR OFFER: NO CHARGE FOR EXAMINATION AND INSTRUCTIONS.

HAVE YOU AN IDEA?

YOUR FIRST STEP before disclosing an invention the inventor should write for our blank form **"Record of Invention"** This should be signed and witnessed and returned to us together with model or sketch and description of the invention for examination and instructions. *No charge for the above information.*



Our Three Books Mailed Free to Inventors

Our Illustrated Guide BOOK

How to Obtain a Patent

Contains full instructions regarding U. S. Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Assignment or SALE OF PATENTS, Patent Practice and Procedure, and Law Points for inventors.

Our Trade Mark Book

Shows the value and necessity of Trade-Mark Protection and gives information regarding Trade-Marks and unfair competition in trade.

Our Foreign Book

We have Direct Agencies in all Foreign Countries. We secure Foreign Patents in shortest time and lowest cost.

SPECIALIZATION Our Staff

The field of invention is so vast that it is impossible for any one to become an expert in all the different classes of invention. For this reason Victor J. Evans & Co. employ a number of patent lawyers and expert draftsmen who have been selected for their special knowledge and ability in certain lines of invention.

RADIO AND ELECTRICAL CASES A SPECIALTY

All communications and data submitted strictly confidential.

THE VALUE OF YOUR PATENT

Will depend upon the skill and care with which your case is handled. We spare neither time nor pains to secure the broadest possible patents. We shall be happy to meet inventors in person at our offices or to advise them by letter, and they are at liberty to write us any time they desire information. Their plans will receive careful consideration, an honest opinion and a prompt reply. We have a personal interest in the successful outcome of every case we handle, and inventors can rely on receiving the highest grade of work and the most thorough service from us.

WE REGARD A SATISFIED CLIENT

As our best advertisement, and will furnish to anyone, upon request, lists of clients in any state for whom we have secured patents.

Highest References—Prompt Attention—Reasonable Terms

—WRITE TODAY—

**Free
Coupon**


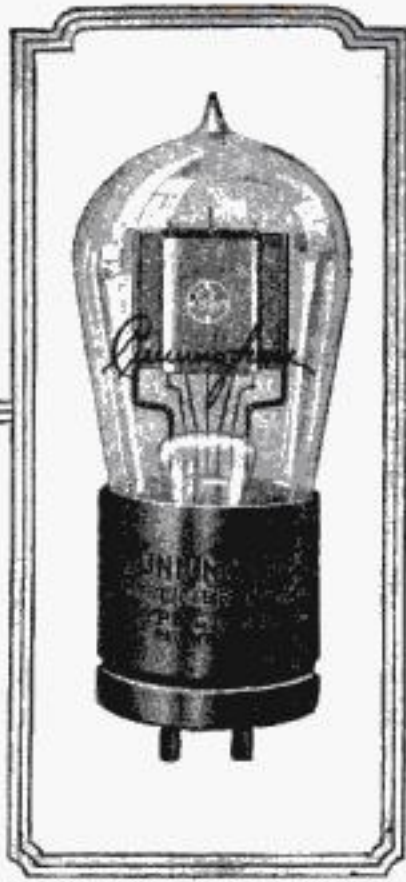

VICTOR J. EVANS & CO.
Patent Attorneys

New York Offices 1007 Woolworth Bldg. Philadelphia Offices 714-715 Liberty Bldg. Pittsburgh Offices 514 Empire Bldg.
Chicago Offices, 1114 Tacoma Bldg. San Francisco Offices, Hobart Bldg.

Main Offices: 760 Ninth Street, Washington, D.C.

Gentlemen: Please send me FREE OF CHARGE your books as described above.

Name..... Address.....



CUNNINGHAM RADIO TUBES

C-301A — 5 Volts 1.4 ampere filament, \$6.50
C-299 — 3 Volts .06 amp. Dry Battery Det. and Amp. \$6.50
C-300 — 5 Volts Gas Content Detector, \$5.00
C-11 — 1.1 Volts 25 amp. Dry Battery Det. and Amp. Special Base, \$6.50
C-12 — Similar to C-11 with standard base, \$6.50

PATENT NOTICE

Cunningham tubes are covered by patents dated 11-7-05, 1-15-07, 2-18-08, and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

Type C-301A gives greater Power Amplification with only $\frac{1}{4}$ Amp. Filament Current.

Cunningham

RADIO TUBES

For Every Make of Receiving Set

THROUGHOUT the entire country today Cunningham Radio Tubes are recognized as the ideal tube for use in all makes of Radio Receiving Sets.

The famous Cunningham C-301A Amplifier shown above is a high vacuum tube designed for use as an amplifier and detector containing a new Tungsten Filament, the characteristics of which are long life, low power consumption, low operating temperature and greater power amplification than any previous amplifier tube.

This tube has a standard four prong base, and the glass bulb has the same dimensions as C-300 and C-301. The filament current is only one-fourth of the filament current of the previous type of Amplifier tube and it is, therefore, possible to use four of these tubes in a set without exhausting the storage battery any faster than when using only one of the previous types of tubes. The care and operation of each model of Receiving Tube is fully explained in our new 40 page "Radio Tube Data Book." Copies may be obtained by sending ten cents in stamps to our San Francisco office.

Home Office:
182 Second Street
San Francisco

154 West Lake St., Chicago



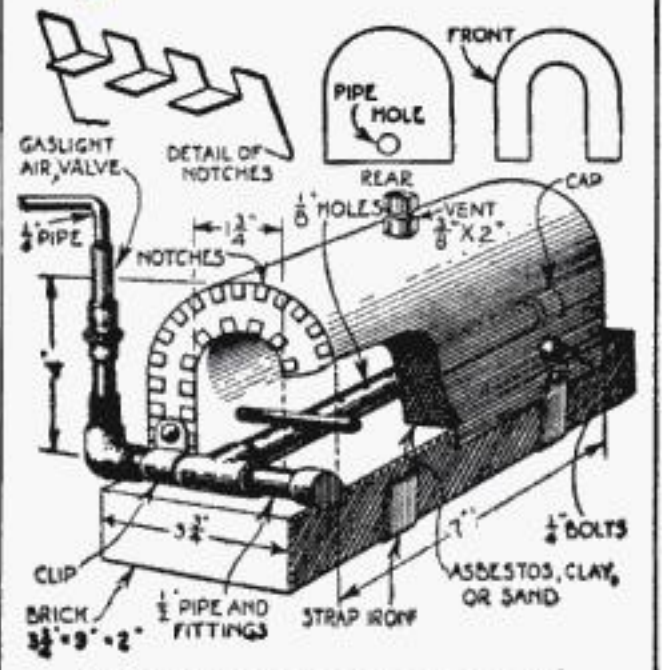
E. J. Cunningham Inc.

30 Church St., New York

Double Wall Soldering Furnace Heats Coppers Quickly

FOR some time I have been using a soldering furnace made from odds and ends found around my home workshop. It is economical in the use of gas and will heat a medium soldering iron in about a minute and a half.

The base is made of vitrified brick. The furnace hood is composed of sheet metal, bent and fastened as shown. Straps riveted to it are turned under the base.



The heavily insulated hood over the gas burner prevents loss of heat

The space between the outer casing and the inner lining is filled with sand, clay, or asbestos.

The burner is made up of $\frac{1}{2}$ -in. pipe, ells, and caps. The 9-in. length of pipe, which extends into the furnace, has fifteen $\frac{1}{8}$ -in. holes drilled into it. These holes are grouped near the tee, so that at least $4\frac{1}{2}$ in. of the pipe toward the capped end will serve as a chamber for retaining air. An air port for a gas light is connected as shown, and is a push fit in a $\frac{1}{2}$ -in. nipple. Use three $\frac{5}{8}$ -in. bolts 4 in. long through the hood as rods upon which to rest the soldering iron.—LORIN A. BROWN, Washington, D.C.

Learn in Spare Time to be a CIVIL ENGINEER

Earn \$1500 to \$5000 Yearly

Here's your big chance to become a full fledged Civil Engineer! With this set of books you can fit yourself to make big money in the greatest outdoor profession on earth! Offer fully explained in coupon. Good only within boundaries of the U. S. and Canada.

Great Book Shipped FREE

75c a Week If you keep them after 7 days' FREE TRIAL.

Nine big leather-bound volumes; 3900 pages 5 1/2 x 8 inches; 3000 plates, maps, diagrams, etc. Written by world's greatest civil engineers. Books tell you ALL ABOUT surveying; highway construction; railway engineering; earth work; specifications; estimating contracts; bridge engineering; masonry; reinforced concrete; water supply; sewers and drains; water power equipment; irrigation engineering—etc., etc. Written in simple language—every point made plain.

Consulting Service Free

A \$12 Consulting Membership solves your difficult problems for a whole year. FREE with the set of books.

SEND NO MONEY—JUST THE COUPON

NAME _____

ADDRESS _____

REFERENCE _____

AMERICAN TECHNICAL SOCIETY

Dept. C-220, Chicago, U.S.A.

Please send Library of Civil Engineering for seven days' examination, express collect. I will send \$2.50 within seven days and \$3.00 a month until I have paid \$24.00 or notify you and hold books subject to your order. Title not to pass until fully paid.

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed RIGHT NOW. Your brains can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation" and learn more about making money from ideas than you ever knew before. It tells many things that are wanted, too. A postal will do—**It is free.**

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.

Don't delay—get the book at once.

AMERICAN INDUSTRIES, INC.

201 Patent Dept.
WASHINGTON, D.C.

PATENTS ADVERTISED For SALE FREE

In INVENTION And MANUFACTURING SUPPLEMENT.

Published for the man with "an idea." Send for free sample copy. One year's subscription 50c.

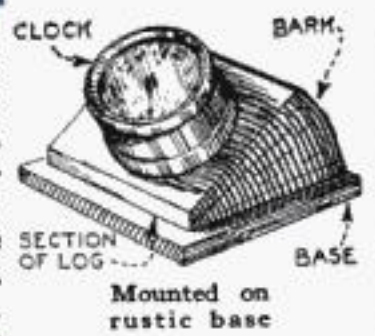
Old Auto Clock Converted into Desk Ornament

THE dashboard clock from an old dismantled auto, or even a cheap miniature alarm clock can be converted into an ornamental desk clock by mounting it on a triangular block cut from the limb of a tree.

The wood is shaped as shown, care being taken to leave the bark intact. A hole is cut into the block with an expansive bit to suit the clock. If an alarm clock is used, a somewhat smaller hole is bored deeper into the wood to make a recess for keys.

A thin board is cut slightly larger than the block to act as a base. All but the bark-covered side of the wood should be carefully smoothed, scraped, sandpapered, and varnished.

FRANK W. HARTH, Bayside, N. Y.



Saving Money in Building

(Continued from page 81)

a balustrade is set in place after it is constructed, surplus should be allowed for fitting.

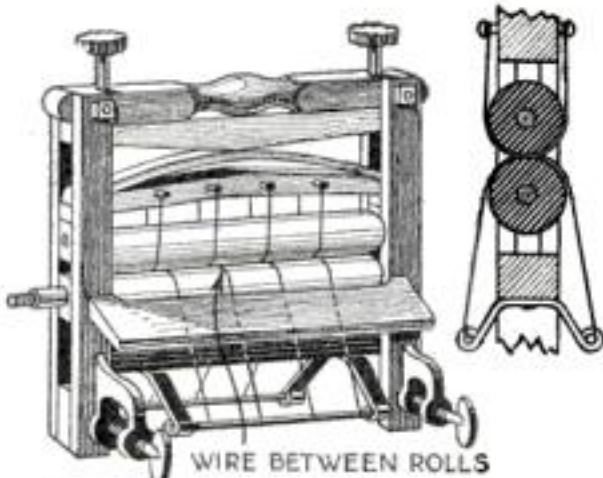
Another useful idea is the method shown in Fig. 2 of reversing plowed window jambs of the double-hung type for use in casement or French windows. This idea can be used for windows opening either in, as shown, or out, and is much cheaper than the usual form of construction.

One other useful "kink" is shown in Fig. 2. I have often found it necessary to make splices or mitered joints, and this can be done quickly and accurately by nailing the two pieces to be joined together temporarily and making a cut at random through both of them. This will always give a perfect fit.

Simple Wire Guards Prevent Wringer from Jamming

LIGHT pieces of clothing and linen often stuck to the wet rollers of the power wringer on our electric washing machine. They would wind around until the machine jammed and this sometimes tore the cloth and broke buttons, as well as putting much unnecessary strain on the gear.

To overcome this difficulty, I attached four strands of No. 18 copper wire with



The guide wires stop light articles from clinging to the rollers and clogging them

screws as shown to guard the upper and lower rolls. After they were in place, I started the wringer and screwed the upper roller down tight. The wires cut into the soft rubber about $1/32$ in., enough to hold them in place.

The device has worked well not only on our own wringer but on several others to which I have applied it. The wires do no damage to the clothing and the buttons will not catch if they are turned in as is always required in using a power wringer.

—WALTER T. MARKOWSKI, Camden, N.J.

Combination Ink-Pencil Eraser Removes Rust from Knife

HAVING a gold penknife, the blades of which were becoming ruined from non-use and rust, the writer cleaned the steel with an ordinary combination ink-pencil eraser. The rust quickly vanished upon being rubbed with the ink part of the eraser, and the pencil part of the eraser polished the blades.—K. M.

PATENTS

Seventy-six Years of Practice

THE firm of Munn & Company filed its first application for a patent in 1846, and for seventy-six years has endeavored to keep pace with the inventive genius of the United States. An experience of many years is at your disposal. If you have an invention which you wish to patent, send your sketches or model together with a description of your device, explaining its operation, and you will receive prompt, courteous attention.

Write for our Handbook on PATENTS

A full and complete booklet on Patents, Designs, Trade-Marks, Foreign Patents, Copyrights, Labels and Patent Office Practice with an explanation about our methods, terms, etc.

All communications strictly confidential

Keep in touch with the inventions of the world by reading
SCIENTIFIC AMERICAN

The *MONTHLY MAGAZINE* with a special appeal to every man of inventive genius. Recent rulings of the Patent Office, descriptions of the latest patented inventions, legislation and court decisions affecting patents, are noted in this authoritative publication.

MUNN & COMPANY

Patent Attorneys

683 Woolworth Building, New York City

Scientific American Bldg., Room 3, 625 F Street, Washington, D. C.

801-D, Tower Building, Chicago, Ill.

602 Hobart Bldg., San Francisco, Cal.

INVENTORS

PROTECT YOUR IDEAS

Send for our Guide Book, **HOW TO GET A PATENT**, and Evidence of Invention Blank, sent Free on request. Tells our terms, methods, etc. Send model or sketch and description of your invention and we will give our opinion as to its patentable nature.

RANDOLPH & CO.
Dept. 130, Washington, D. C.

NAME.....

STREET.....

CITY..... STATE.....

SMASH

Your Way Through to SUCCESS!



Lionel Strongfort
The Perfect Man

LIFE'S race is to the STRONG. The fittest survive. The weakling perishes. Your Success in business, in society, in all the relations of life, depends fundamentally on your Physical Health and Strength. If you have some physical weakness gnawing at your vitals and robbing you of the very essence of success, you are a beaten man.

You Can WIN

Life's biggest prizes are YOURS if you have the Physical Power to DEMAND them. Where do you stand? Are you a business drudge—one of the "Yes, Sir" boys, humbly taking orders from others who haven't half your ability but who DO have a surplus of Health and Energy? Or—Are you the fighting, planning, DOING sort of MAN—the man who leads and directs other men—the man who is respected and looked up to by men and women alike? Are you? You CAN be.

It's EASY

My amazing discovery of the workings of Natural Forces makes gaining of glorious health and physical strength EASY—and as natural as breathing. By my methods, YOU can acquire perfect Health, Lion-like Strength, and compelling Personal Power. I can help you as I have helped thousands. I will put you on the high road to MASTERFUL Achievement. I will put the punch and power in you that will enable you to smash your way through to Success.

I build men scientifically through STRONGFORTISM, The Modern Science of Health and Strength. Results are astounding—almost miraculous. I have lifted thousands of men from the deep pit of failure and despair and shown them how to gain Health, Strength and Vitality. No matter if you are weak, ailing, nervous or the victim of some stubborn chronic ailment, I can put you back in the game and give you the fire and energy of Physical Perfection.

Startling Book FREE

STRONGFORTISM—the Science that makes physical and mental super-men out of weaklings, that makes business giants, social successes and leaders in trade and commerce out of weak, disease-racked, discouraged, hopeless men, is fully described in my new book, "Promotion and Conservation of Health, Strength and Mental Energy." Let me send you a copy of this FREE book, beautifully illustrated from living figures and crammed with startling facts. Fill out the Free Consultation Coupon and send to me TODAY with ten cents (one dime) to cover mailing cost.

LIONEL STRONGFORT

Physical and Health Specialist

Dept. 1360 Newark, New Jersey

CONSULTATION COUPON—Absolutely Confidential

Lionel Strongfort, Dept. 1360, Newark, N. J.
Please send me your big 54 page book. I enclose ten cents (one dime) for postage. Send me special information on subjects marked (x) below without obligation.

Colds	Despondency
Catarrh	Skin Disorders
Too Fat	Debility
Too Thin	Torpid Liver
Stomach Trouble	Muscular Development
Flat Chest	Great Strength
Bad Blood	Rupture
Nervousness	Lumbago
Constipation	Neuralgia

Other Ailments.....

Name.....

Age..... Occupation.....

Address.....

Edison, the Man

(Continued from page 32)

table, roll his coat about them for a pillow and lie down to sleep for an hour or two.

"A soft bed spoils a man," he had a habit of saying at such times.

He might have gone home to sleep, for he lived only a short distance from the laboratory, but it was characteristic of him, of his thoughtfulness and consideration for others, that he preferred to snatch a short nap with his assistants.

Besides his enthusiasm, his energy, his inventive genius, Edison's chief characteristic, I would say, always has been his sense of humor. No work ever was too serious for him to see the funny side of it—if a funny side happened to develop.

In the spring and summer of 1879, I remember, the bulbs we were using in the lamp experiments were being made by Ludwig Boehm, an expert glass-blower from Bonn, Germany. Edison had discovered that the lamp filaments were more durable and the light more brilliant when the filaments were inclosed in a high vacuum. Boehm was experimenting to find the best method of obtaining a complete vacuum and then sealing the bulb to retain it. One day some one suggested to Boehm in the hearing of Mr. Edison that the bulbs be taken up in a balloon to a height above the atmosphere where no air could reach them.

A "Brilliant Idea" Wasted

"That's a good idea," said Mr. Edison with a merry twinkle in his eye. "I think we ought to get a patent on that."

"And how," the practical Boehm demanded, "are you to seal the bulbs without any air to use in the blowpipe?"

"There you are," exclaimed Edison in feigned chagrin. "A man can't advance a brilliant idea without somebody trying to show him some reason why it can't be done. There's not much chance for an inventor nowadays."

When I heard that Edison was bringing old Jep Bisbee from Michigan to fiddle for the phonograph, I was not at all astonished, for Edison always has been most loyal to his friends. Thus, J. V. MacKenzie, the old Scotchman who had first taught Edison telegraphy, used to stay at Menlo Park for months at a time and had a free run of the laboratory. He was good-natured, happy-go-lucky—anything but the typical thrifty Scotchman. He used to stroll about the laboratory or sit beside the stove telling excruciatingly funny stories in Scotch, German, and Irish dialects.

One day when Mr. Edison was carbonizing various substances to serve as a basis for lamp filaments, his eyes happened to fall on MacKenzie's heavy, red beard.

"There's something we haven't tried yet!" he cried, and as he spoke he plucked a wisp from the whiskers.

"The Edison-MacKenzie" lamp, as Mr. Edison styled the bulb in which the old Scotchman's hair served as a filament, burned with a peculiar reddish glow.

"And what would you expect, boys," Mr. Edison asked us, pointing to the color of the light, "when we've used such fiery

(Continued on page 141)

U.S. PATENTS



DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form "EVIDENCE OF CONCEPTION" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them,—a post card will do.



274 Ouray Bldg.

WASHINGTON, D. C.

Originators of forms "Evidence of Conception."

HAVE YOU AN INVENTION?

If so the WORLD PROGRESS will show you how to

Protect and Profit From Your Ideas

Sample copy free. One year's subscription \$1.00. Send for free book.

"WHAT TO INVENT"

containing Suggestions to Inventors as to Inventions Needed. We invite manufacturers to address us regarding inventions they want.

WORLD PROGRESS PUB. CO., INC.
Room 202 Victor Bldg. Washington, D. C.



FREE
Fine Tone
\$20 Musical Instruments
We have a wonderful new copyrighted system of teaching note music by mail. To first pupils in each locality we will give free a \$20 superb Violin, Tenor Banjo, Ukulele, Hawaiian-Guitar, Banjo, Mandolin, Banjo-Ukulele, Banjo-Mandolin, Cornet or Banjo-Guitar absolutely free. Also teach Piano and Organ. Very small charge for lessons only. Four lessons will teach you several pieces. Over 100,000 successful players. We guarantee success or no charge. Complete outfit free. Write today, Dept. 166, No obligation. Slingerland School of Music, 1815 Orchard St., Chicago, Ill.



One Charger for All Batteries

Charges 2-volt peanut tube batteries, 6-volt A Batteries, 6- and 12-volt automobile batteries, and 1 to 4 B Batteries. It's the

Valley Type ABC Battery Charger

VALLEY ELECTRIC CO., St. Louis, Mo.

PATENTS

BOOKLET FREE HIGHEST REFERENCES PROMPTNESS ASSURED BEST RESULTS

Send drawing or model for examination and report as to patentability

WATSON E. COLEMAN, Patent Lawyer
644 G Street N. W., Washington, D. C.

PATENTS

TRADE-MARKS, COPYRIGHTS AND PATENT LITIGATION

Write for advice and instructions how to proceed, costs, etc. Hand Book with illustrations of 100 Mechanical Movements sent free on request.

ALBERT E. DIETERICH

Patent Lawyer and Solicitor

Successor to Fred G. Dieterich & Co.
681A Ouray Bldg. WASHINGTON, D. C.

Secret Service

Stop That Leak

anywhere in automobile cooling system with the only liquid that is guaranteed to **permanently** mend all leaks almost at once. A secret formula that is always at your service.

RADIATOR NEVERLEAK

poured into the water in your radiator mends leaks as fast as they appear, prevents rust and scale from forming and adds years to the life of the radiator. Cannot injure or clog cooling system in any way. Entire satisfaction or money refunded.

Price 50c and 75c a can. Write for free "Secret Service" booklet.

Buffalo Specialty Company
365 Ellicott St.
Buffalo, N. Y.



FORDS run 34 Miles

(on Gallon of Gasoline)

Low Gear Seldom Used

With Air-Friction Carburetor

And we guarantee all other cars nearly double present mileage, power and flexibility, make hills on high formerly difficult on low. Models for any car, truck, tractor, marine or stationary engine. See wonderful mileage guarantees—on gallon of gasoline for other cars. Makes old cars better than new.

Ford ... 34 mi.	Reo ... 24 mi.	Chevrolet ... 32 mi.
Buick 4 ... 30 mi.	Chal'ra ... 23 mi.	Maxwi(25) ... 30 mi.
Buick 6 ... 24 mi.	Olds ... 23 mi.	Nash 6 ... 23 mi.
Hudson ... 20 mi.	Paige 6 ... 20 mi.	Lincoln 8 ... 17 mi.
Hupp ... 25 mi.	Oakl'd 6 ... 24 mi.	Stdbkr L6 ... 23 mi.
Dodge ... 28 mi.	Overl'd 4 ... 32 mi.	Cole 8 ... 17 mi.

If your car is not mentioned here send name and model for particulars and our guarantee on it. Agents Wanted.

SENT ON 30 DAYS' FREE TRIAL
You can drive any car in heaviest traffic without shifting gears. Starts off on high in any weather without priming or heating—no jerking or choking. No more foul spark plugs or carbon in cylinders. No leaking of gas into crank case. Try it 30 days on our guarantee of money back if not entirely satisfied. No strings to our guarantee. **YOU ARE THE JUDGE.** Anyone who can handle a wrench can attach it. No boring of new holes or changing of operating mechanism. Write today.

AIR-FRICTION CARBURETOR CO.
593 Raymond Bldg. Dayton, Ohio, U. S. A.

AGENTS \$6 A DAY

taking orders for Non-Alcoholic Food Flavors. Every variety. Put up in collapsible tubes. Always fresh. Three times the strength of bottled flavors. Not sold in stores. Fast repeaters. Big income every day.

Men and Women
devoting full time can make \$6 to \$10 a day. Big money for spare time. Largest concern of its kind in the world. Over two million dollars' worth of orders taken last year by our Representatives for Zanol Food Products, Toilet Preparations, Soaps, Laundry and Cleaning Specimens and House-hold Supplies. Every article guaranteed. Write for Sample Outfit and Money Making Proposition.

American Products Co.
238 American Building, Cincinnati, Ohio



3 WEEKS FOR 15 CENTS

The Pathfinder

SHOWS THE WAY THROUGH THE JUNGLE OF EVENTS

You've heard your neighbor praise the Pathfinder, the wonderful weekly news and story magazine with over half a million subscribers. Unbiased digest of national and world affairs. Check full of just the kind of reading you want. Fun, fashions, question box, books, health—entertainment and instruction for all. Exciting serial and short stories. Send 15c (coin or stamps) today for this big \$1 paper 13 weeks. Money back if not satisfied. Sample copies free.

PATHFINDER, 551 Langdon St., Washington, D. C.

Edison, the Man

(Continued from page 140)

whiskers as those?"

That Edison, famous for his industry and energy, should have possessed real affection for so carefree a man as the old Scotchman is not remarkable. To MacKenzie he owed, in a way, a tremendous debt, for Edison's first introduction to electricity came from the tutelage which the Scotchman had given him in telegraphy.

Nor was it merely to personal friends that Mr. Edison displayed loyalty and kindness. To his employees he always was the most considerate of men. After I had been at Menlo Park for about a year I was attacked by malaria. We were busy at the time, and I made no mention of being ill, but tried to fight off the illness while I worked. One day, though, Mr. Edison called me aside.

"Francis," he said, "I've noticed you haven't been looking well of late. I think you ought to go to Asbury Park and stay three or four weeks. That ought to fix you up."

Not only did he relieve me from my duties at the laboratory for a month, but he gave me the money to pay the expenses of my vacation at the seashore.

The Inventor as an Organist

The youngest of us was no more lively than Mr. Edison in his moments of relaxation. He enjoyed nothing better than a good rousing song. Few people probably know it, but in those days at Menlo Park, Mr. Edison was more than a fair performer on the organ. After our midnight lunch at the laboratory he would stroll to the organ at the end of the long room, and soon our voices would be ringing out in the popular songs of the day to his accompaniment. Boehm, the glass-blower, sometimes could be coaxed to play the zither and sing quaint German songs. One of the laboratory boys was an excellent mimic. He had an imitation of the original Edison phonograph, with the tinfoil records, which never failed to elicit peals of laughter from Mr. Edison.

Sometimes Hussy, postmaster of Menlo Park, or Davis, the innkeeper, would join us at these midnight revels. One night Hussy, who sometimes might exaggerate a wee bit, began to tell his life history. Incident followed incident, but the narrator showed no signs of weariness nor of reaching the end of his story. Mr. Edison, who was somewhat deaf even then, sat by, apparently paying no attention to the speaker. Suddenly, though, he took out a piece of paper, scratched some figures on it, and then looking up, said:

"Hussy, how long are you going to keep on working? Up to now I've figured that you've been working more than 150 years! Isn't it about time you took a vacation?"

This was said in an even tone, apparently with perfect good humor, yet we who knew him best saw that Mr. Edison was vexed by the old postmaster's lengthy autobiography. For he always resented being imposed upon or having his credulity taxed even in small things.

Mr. Edison's self-confidence was su-

(Continued on page 142)



Wins a Welcome

You are welcome everywhere with a sweet-toned Buescher Saxophone. It is an infallible key to social popularity.

Everyone has a perfectly normal desire to produce music, but heretofore the making of music has been the privilege of the talented few.

See How Easy It Is

But with a Buescher Saxophone it is different. It is so simple and easy that practically anyone can learn to play.

With the aid of the first three lessons, which are sent free (upon request) with each new Saxophone, the scale can be mastered in an hour; in a few weeks you can be playing popular music. Practice is a pleasure because you learn so quickly. You can take your place in a band within 90 days, if you so desire.



TRUE-TONE SAXOPHONE

For Bands and Orchestras, for church and lodge, and school musical affairs, for social and home entertainment, the Saxophone is the most popular instrument and one of the most beautiful. A good Saxophone player is always popular socially and enjoys many opportunities to earn money. Saxophone players are always in demand for dance orchestras. Every town should have a Saxophone quartette or orchestra. (17)

Try It In Your Own Home

You may order any Buescher Saxophone, Cornet, Trumpet, Trombone or other Band or Orchestral Instrument and try it six days in your own home, without obligation. Easy terms of payment may be arranged if preferred. Mention the instrument interested in and a complete catalog will be mailed free.

Buescher-Grand Trumpet

Especially easy to blow, with an improved bore and new proportions. With the mute in, it blows so softly and sweetly that practice never annoys. A splendid home instrument.



Free Saxophone Book

We have prepared a very interesting book on the history and development of the Saxophone. It tells which saxophone takes violin, cello and bass parts and many other things you would like to know. Also illustrates first lesson. Every music lover should have a copy. It is sent free on request. Just send your name for a copy.

BUESCHER BAND INSTRUMENT CO.

Everything in Band and Orchestra Instruments

3117 Buescher Block Elkhart, Indiana

Buescher Band Instrument Co. 3117 Buescher Block, Elkhart, Ind.			
Gentlemen:			
I am interested in the instrument checked below:			
Saxophone	Cornet	Trombone	Trumpet
(Mention any other instrument interested in)			
Name.....			
Street Address.....			
Town..... State.....			



"Good Bye, Boys!"

"Today I dropped in for a last word with the boys at the office. And as I saw Tom and Dave there at the same old desk it came to me suddenly that they had been there just so the day I came with the firm four years ago.

"When I started here I was put at a desk and given certain routine things to do. But after a few months I began to realize that I was nothing but a human machine and that I couldn't expect to advance that way.

"So I wrote to Scranton and arranged for a spare time study course that would give me special training for our work. Why, do you know, it gave me a whole new interest in our business? In a few months I was given more responsibility and more money. Since then I've had three increases, six months ago I was put in charge of my department, and now my big chance has come—I'm to be manager of our Western branch at \$5,000 a year! It just shows what spare time training will do."

If you want to make more money, show your employer you're trying to be worth more money. If you want a bigger job, show him you're willing to prepare for it.

There's a simple, easy way to do it. For 32 years the International Correspondence Schools have been training men and women right in their own homes whenever they had a little time to spare. Thousands of men and women have stepped up in just this way. More than 150,000 are studying now. Ten thousand are starting every month.

Can you afford to let another priceless hour pass without finding out what the I. C. S. can do for you? Here is all we ask—without cost, without obligation, mark and mail this coupon.

INTERNATIONAL CORRESPONDENCE SCHOOLS

Box 7674-C, Scranton, Penna.
Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject before which I have marked an X:

BUSINESS TRAINING COURSES

- | | |
|--|---|
| <input type="checkbox"/> Business Management | <input type="checkbox"/> Salesmanship |
| <input type="checkbox"/> Industrial Management | <input type="checkbox"/> Advertising |
| <input type="checkbox"/> Personnel Organization | <input type="checkbox"/> Better Letters |
| <input type="checkbox"/> Traffic Management | <input type="checkbox"/> Show Card Lettering |
| <input type="checkbox"/> Business Law | <input type="checkbox"/> Stenography and Typing |
| <input type="checkbox"/> Banking and Banking Law | <input type="checkbox"/> Business English |
| <input type="checkbox"/> Accountancy (including C.P.A.) | <input type="checkbox"/> Civil Service |
| <input type="checkbox"/> Cost Accounting | <input type="checkbox"/> Railway Mail Clerk |
| <input type="checkbox"/> Bookkeeping | <input type="checkbox"/> Common School Subjects |
| <input type="checkbox"/> Private Secretary | <input type="checkbox"/> High School Subjects |
| <input type="checkbox"/> Spanish <input type="checkbox"/> French | <input type="checkbox"/> Illustrating |

TECHNICAL AND INDUSTRIAL COURSES

- | | |
|---|--|
| <input type="checkbox"/> Electrical Engineering | <input type="checkbox"/> Architect |
| <input type="checkbox"/> Electric Lighting | <input type="checkbox"/> Blue Print Reading |
| <input type="checkbox"/> Mechanical Engineer | <input type="checkbox"/> Contractor and Builder |
| <input type="checkbox"/> Mechanical Draftsman | <input type="checkbox"/> Architectural Draftsman |
| <input type="checkbox"/> Machine Shop Practice | <input type="checkbox"/> Concrete Builder |
| <input type="checkbox"/> Railroad Positions | <input type="checkbox"/> Structural Engineer |
| <input type="checkbox"/> Gas Engine Operating | <input type="checkbox"/> Chemistry <input type="checkbox"/> Pharmacy |
| <input type="checkbox"/> Civil Engineer | <input type="checkbox"/> Automobile Work |
| <input type="checkbox"/> Surveying and Mapping | <input type="checkbox"/> Airplane Engines |
| <input type="checkbox"/> Metallurgy <input type="checkbox"/> Mining | <input type="checkbox"/> Agriculture and Poultry |
| <input type="checkbox"/> Steam Engineering <input type="checkbox"/> Radio | <input type="checkbox"/> Mathematics |

Name.....
Street.....
Address.....
City..... State.....

Occupation.....
Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

Edison, the Man

(Continued from page 141)

perb. The present generation, accustomed all its life to obtaining light by the simple act of pressing a button, probably will have difficulty in imagining the ridicule and criticism that met Edison's efforts to develop the ancestor of the electric lamps that light our homes. It is even more difficult to believe that some of the foremost scientists of the time went so far as to call Edison, in effect, an ignorant and deluded man. But criticism, no matter how bitter, bothered him not at all. He was certain that eventually he would solve the problem of producing the incandescent light, and his faith in himself made him impervious to the attacks of his critics.

Typical of the criticism of Edison by the scientists of those days was that of Sylvanus P. Thomson, a great English electrician, who spoke of Edison's "airy ignorance," and made the positive statement that any system of lighting dependent upon incandescence would fail. Not only that, but he proved it to the satisfaction of many!

Unmoved by Critics' Attacks

W. H. Preece, electrician to the British Post Office Department, one of the greatest English electricians, and a pioneer in wireless telegraphy, pledged his reputation to the assertion that Edison's idea was a "mere chimera" and was doomed to ignominious failure. Mr. Edison likes to remember that Preece later became one of his warmest friends and staunchest admirers. Other scientists declared it absurd that a man like Edison, who was "not even a mathematician," should presume to set himself to the solution of problems that had baffled learned scientists.

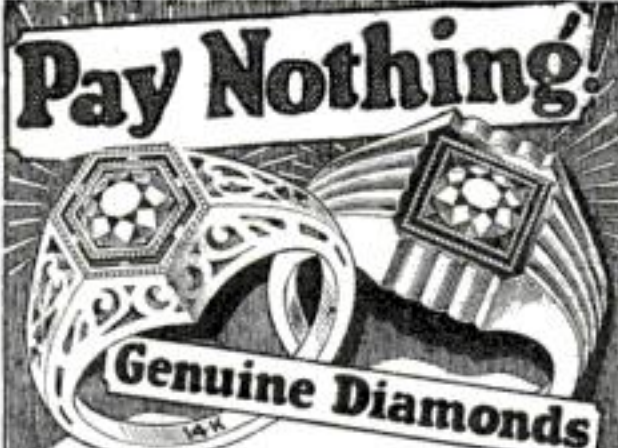
None of these attacks, however, ever brought from Edison a reply or a counter-charge. Reporters from the New York, Philadelphia, and Boston newspapers were besieging the Menlo Park laboratory constantly, laying the latest charges of his critics before Mr. Edison and seeking to arouse him into making a sensational statement in reply. Usually he warded off the questions of his visitors diplomatically. Sometimes he became a little impatient. One day he said:

"I'm not working at the electric light for the sake of making a public exhibition of it, nor for the sake of announcing each step I take. I am working for a company, the Edison Electric Illuminating Company, and my only business is to supply that company with a perfect system of electric lighting."

He knew he would be successful, and he knew as well that his success would be the most formidable answer to his critics.

Not that he was entirely careless of criticism. On the contrary, he was eager to read every line printed about him and his work. It supplied him, I believe, with a spur, driving him on to increased efforts. Whenever any of us would come across a particularly savage attack, Mr. Edison would read it; then he would smile and say, "Never mind, boys. They'll not only be reading by incandescent lamps soon,

(Continued on page 143)



Save 25% on this solid gold, genuine diamond ring. Read this—the most amazing free trial offer ever made.

No Money Down—No C.O.D.

Mail the coupon below—don't enclose a penny—and we'll send you either the man's or lady's ring shown above on trial, all charges prepaid. Pay nothing when the ring arrives—no C.O.D. wear it a week—then decide. If you can duplicate this ring for \$50.00 anywhere, send it back at our expense and that ends the matter. If you decide to buy, send \$3.75 after trial, and pay \$3.75 a month until our special cut price of \$38.75 is paid. (Over 10 months to pay—no interest). Each ring is 14K solid gold, exquisitely hand made, engraved and beaded. The 18K white gold top is set with an extra brilliant, blue white, perfectly cut, top-quality genuine diamond. (Regular \$50.00 value—now only \$38.75). You risk nothing on this wonderful offer! Mail coupon today! Be sure to state finger size.

Mail This Coupon

Harold Lachman Co., 204 So. Peoria Street, Dept. 1752 Chicago, Ill.

Send me free of all charges the solid gold, genuine diamond ring checked below, for a week's free trial. I enclose no money—I will pay nothing on arrival. At the end of one week I will either return the ring to you by registered mail, or send you first payment of \$3.75, and then \$3.75 on the first of each month until your cut price of \$38.75 has been paid. Title remains with you until fully paid. I enclose my finger size.

☐ Lady's Ring A4550. ☐ Man's Ring A4450.

Name.....

Home Address.....

City..... State.....

Age..... Occupation.....

Copyright 1923, Harold Lachman Co.

BOYS! BOYS! BOYS!

THROW YOUR VOICE

Into a trunk, under the bed or anywhere. Lots of Fun fooling the Teacher, Policeman or Friends.

THE VENTRILO,

A little instrument, fits in the mouth out of sight, used with above for Bird Calls, etc. Anyone can use it. NEVER FAILS. Also a 32 PAGE BOOK which gives full instructions on Ventriloquism. Formula for Secret Writing (Invisible Ink), 12 Money Making Secrets and 10 BIG TRICKS ON MAGIC all for 10¢. ROY. NOV. CO., Dept. 322 So. Norwalk, Conn. LARGEST and OLDEST Mail Order House in Connecticut.

Agents—Here It Is

The New Serenola

Something new and different. Something you can sell easily and quickly. Orders waiting everywhere. Baird sold 23 in one week, his profit over \$150. The Serenola is built in just like a suitcase. Carried with you anywhere. Does more than machines costing 5 times its price.

Fully Guaranteed

Get started at once. No experience needed. We deliver and collect. Pay you every day. Work full or spare time. Write or wire us for terms and territory.

PERRY-LUDLOW CO., S-1847 Dayton, Ohio



You can earn \$15 to \$50 a week writing show cards in your own home. No canvassing. A pleasant profitable profession easily and quickly learnt by our new simple graphic block system. Artistic ability not necessary. We teach you how, and supply you with work—Distance no object. Full particulars and booklet free. WILSON METHODS LIMITED—DEPT. 3-B 64 East Richmond, Toronto, Canada.

The Real Metal Solder in Paste Form

SOLDERALL

Introducing Our New SOLDERALL BLOW TORCH of Heavy Solid Brass

Indispensable in the Home, Garage and to the Electrician. For soldering Radio, House Wiring, Jewelry Ignition, Kitchen Utensils, etc.

Improved \$1.25
Blow Torch

SOLDERALL TUBE 25¢

SOLDERALL CO. Dept. A Newark, N.J.

Edison, the Man

(Continued from page 142)

but they'll be running their elevators and sewing machines, and cooking their meals by electricity, too!"

I never saw Mr. Edison discouraged—not even in the days when, after experimenting with platinum lamps, he gave them up and sought again to develop a carbon filament. At that time people were fond of comparing the incandescent lamp with the Keeley motor. Mr. Samuel Insull, now head of the power industries of the Middle West, who once was Edison's secretary, however, tells of one time when the inventor became pessimistic.

"Sammy," Mr. Insull says Edison asked him one day, "do you think you can earn a living again as a stenographer? Because, if you do, I think I can earn my living as a telegraph operator. That will make us certain of having something to eat anyway."

That was in 1883 when Edison had started a lamp factory and the whole future of the Edison light system depended on its success. And it was a matter of financing a giant project, not of developing an invention, that had brought doubt of success to Edison's mind. Lacking sufficient capital, Edison nevertheless had plunged into the business of manufacture, because he alone possessed sufficient faith in the future of electric lighting to do so. Though it was costing him between one dollar and one dollar and fifty cents to manufacture each lamp, he had taken a contract to sell lamps at 40 cents apiece! Scant wonder that he saw visions of starting all over again as a telegrapher in order to live!

Edison's Critics Silenced

He and Insull, though, attacked their apparently hopeless task with courage and determination. They pored over accounts and managed to meet the payroll somehow until Edison had placed his factory on a sound economic basis. At last the tide turned. The public woke up to the fact one day that the Edison factory was actually paying dividends. Edison's critics were silenced!

Problems equally difficult confronted Edison while erecting the first permanent commercial central electric-light station in the world in Pearl Street, New York City. Here again his indomitable perseverance overcame apparently insurmountable obstacles. Mr. John W. Lieb, now vice president of the New York Edison Company, was the first electrician of the Pearl Street station and participated in those stirring events.

While Edison was establishing these stations, there were times when all of us at the laboratory worked 36 or 48 hours at a stretch—sometimes longer. For the revolutionary undertaking necessitated the development of many inventions. The electric transmission line of those days was a single circuit, supplying current to arc lamps connected in series, which meant that when one lamp got out of order every lamp in the circuit went dark.

Yet even at the height of the work,

(Continued on page 144)

ONLY
\$3
DOWN
and you
keep this
typewriter



DIRECT
to you
from our
Factory
Big Saving
in Price

Yes, we will ship you this
Genuine Underwood

Rebuilt in our own factory just like new for
ONLY \$3 down—NOT ONE CENT MORE

Until you have tried the machine 10 full days at our expense



Our Factory

EVERY MACHINE is fully guaranteed. New parts wherever needed. New enamel, new nickel, new lettering, new platen, new key rings, new type—a complete, perfect typewriter. Impossible to tell it from a brand-new Underwood either in appearance, durability or quality of finished work.

An up-to-date machine with two-color ribbon, back spacer, stencil device, automatic ribbon reverse, tabulator, etc. In addition we furnish FREE waterproof cover and special Touch Typewriter Instruction Book.

You can learn to operate this Underwood in one day.

Big Book FREE

Our big, handsomely illustrated catalog will be sent free on request. It tells you all about the advantages of owning a STANDARD SIZE UNDERWOOD; how and why this machine will last for years, saving many dollars not only in the purchase price, but in its operation.

Send in the coupon and let us send you this beautifully illustrated book FREE without any obligation whatever.

SHIPMAN-WARD MFG. CO. "Typewriter Emporium"
2142 Shipman Building Montrose and Ravenswood Avenues, Chicago

Write Right Now

and learn how it is possible for us to ship you this Underwood Typewriter upon our free trial plan and our direct-to-you money-saving methods. Get the full details now—just sign the coupon and mail today. Get all the facts—then decide.

No Obligation

—to buy. You don't have to order. Just sign the coupon, send it to us and we will mail you our big catalog absolutely free. You will be amazed at the liberality of our offer, the beauty and all around excellence of our typewriters.

Send
Coupon
Today for

10 Days'

Free Trial

You have ten full days in which to try the typewriter before you decide whether you want to keep it. Give it every test—see for yourself—make the Underwood prove its worth to you. Do not take our word for it—put the Underwood before you and see if you don't think it the greatest typewriter bargain ever offered.

This is the genuine Underwood Typewriter. We offer you the same three models of the Underwood Typewriter being made and sold by the manufacturers today. Standard four-row single shift keyboard. Absolutely visible writing—the full line of typewriting is visible at all times. All the improvements and attachments that any high grade typewriter ought to have.

Big Saving to You

Our plan of selling to you direct makes possible enormous savings, which are all for your benefit. Send in the coupon and we will send you prepaid our big catalog, including "A Trip Through Our Factory." This shows how the Shipman-Ward Rebuilt Underwood is the best that can be produced at our Special Price.

You don't have to do a thing to get our big Free catalog and complete details of our amazing typewriter offer except to sign and send in coupon. No obligation.

FREE TRIAL
COUPON

SHIPMAN-WARD MFG. CO.
2142 Shipman Bldg., Chicago

Please send me FREE, all charges fully prepaid, your BIG NEW catalog of UNDERWOOD TYPEWRITERS and complete details of your FREE TRIAL offer. It is understood that I am under no obligation whatever and that this is to be sent without one cent of cost to me.

NAME _____
STREET _____
CITY _____ STATE _____



Ford
Auto
FREE!

We have a plan whereby our active workers can get a Ford without cost, in addition to their big cash earnings. Get the plan—quick!

"I have averaged \$7000

Per Year for Three Years—Have Made
Over \$90 PROFIT in One Day"

That is the statement of Frank DePries, one of our live-wire representatives. Keeton of Mississippi made \$252 on his first sale. Vickers of Alabama made \$118 in one week. Conant quit a \$6,000 job to come with us.



DePRIES

AGENTS WANTED

We need more men like these, because the demand for our Super Fyr-Fyter is growing by leaps and bounds. Sells to garages, stores, factories, schools, homes, hotels, auto owners. Approved by the Underwriters. If you are willing to work and ambitious to make some real money, get our plan. You need no experience, as we train you without cost for the work. No great capital required. Good territory going fast. Better write us at once.

THE FYR-FYTER COMPANY

1714 Fyr-Fyter Bldg.

Dayton, Ohio

What I Learned About Old Age



By
Byram C. Kelley, A.M., L.L.D.

CERTAIN new facts about old age, recently disclosed to me, constitute the most startling information I have ever received. I am 40 years old myself. I had begun to wonder if I would soon begin to "break"

—to lose my old-time pep and aggressiveness, my stamina and resistance to disease. I wondered if I would soon be subject to the class of ailments which seems so prevalent among men past 40. Then through a mutual friend, I made the acquaintance of a member of the American Association for the Advancement of Science, who has recently brought to light most interesting facts about the peculiar conditions common to men past middle age.

Why Many Men Are Old at 40

I had often wondered why so many men begin to lose their vigor and alertness when they are scarcely out of their 30's—yet others, at 60 and 70, seem to be in the prime of life. There must be some reason for this difference. And I found out exactly what this reason is.

65% Have Gland Trouble

I have learned that 65% of all men past a certain middle age have a disorder of a little gland, called the prostate. And prostate disorder is not only the direct cause of much distress, often necessitating operation, but it displays itself in many parts of the body mental as well as physical.

Common Middle Age Ailments

Here is an important cause for many ailments which heretofore have been simply taken for granted as "old age" symptoms—sciatica, aches in back, legs and feet, frequent nightly risings, nervousness and irritability and frequent dizzy spells indicating high blood pressure; and I learned how, by an astonishingly simple new method, that these disorders would be eliminated in many instances in a short time, without drugs or operation—a treatment that reaches this gland directly—yet is so convenient that any one can apply it in their own home.

10,000 Men Find Relief

But most surprising of all, I find that 10,000 men have already found relief. Statesmen, bankers, lawyers, doctors, in every section of the country are using and endorsing the method. I read many letters. One was from a man in Colorado. "73 years young is my age," he wrote, "yet for years I suffered with prostate trouble. Used medicine to no avail—had about given up hope when a doctor recommended your treatment." Just think of a man 73 years old being restored to the health and buoyancy of youth! And it is within the reach of every one. There are no drugs, no books, no electric rays.



73 Years Young

All Explained in FREE Book

If you are troubled with any of the disorders mentioned, if you have chronic constipation or prostate trouble, you should send for a vitally interesting free book, written by this scientist, called "Why Many Men Are Old at 40." It describes this splendid treatment and shows how you may regain much of your youthful vigor and be free from certain disorders. No obligation. But write at once—the edition is limited. Simply mail request to **The Electro Thermal Company, 4030 Main St., Steubenville, Ohio**, the concern that is distributing these books for the author.

Edison, the Man

(Continued from page 143)

Edison never was too busy to see any one who sought him out in his isolated New Jersey retreat to discuss an invention or some other ambitious undertaking. His own experience had taught him the value of encouragement to a pioneer. His own progressiveness caused him to be eager to foster progress in any direction. His kindness made him always willing to help others.

Early in 1879 Lieut. G. W. DeLong, of the United States Navy, who was making preparations for a voyage of arctic exploration, came several times to Menlo Park. Edison became so much interested in his plans that he designed a small dynamo, some incandescent lamps and an arc lamp for his ship, the *Jeanette*, which was being refitted for the expedition by James Gordon Bennett. Since the ship had no steam engine that could be used for the purpose, Mr. Edison designed the little dynamo to be operated by man power—in shifts of two men.

"The boys ought to keep warm up in the arctic, turning that," he observed to Lieutenant DeLong when he showed him the dynamo.

A Visit from Sarah Bernhardt

All of us who worked in the laboratory wrote our names on the paper insulation that was wound on the armature. And somewhere beneath the arctic seas our names have lain for almost half a century, for the *Jeanette* never returned.

Distinguished visitors almost without number found their way to the Edison laboratory even in those early days, for, although scientists were skeptical about the success of the incandescent lamp, Mr. Edison had won fame with other inventions, principally—so far as the public was concerned—the phonograph.

Sarah Bernhardt was one of the visitors of 1880. We were accustomed to seeing Mr. Edison reserved, shy, even, in the presence of strangers. There was little shyness in his manner, though, as he explained the workings of the phonograph that day, a fact which requires no explaining to anyone who ever has seen the Divine Sarah swaying vast audiences in the theater. And that day, for the first time, the voice of an internationally famous artist was recorded on the talking machine.

Madame Bernhardt was transported with amazement when she heard her own incomparable voice and accents reproduced by the record.

"C'est grand! C'est grand!" she exclaimed again and again in frantic enthusiasm.

I cannot believe that Thomas Edison ever received more rapturous praise for any of his achievements than the great French actress bestowed upon him that day. Moreover, I am quite sure that no words he ever heard pleased him more. Since then the world has worn a path to his door, but never in its journeys to the doors of the great has the world numbered among its pathfinders any one more gracious or more charming than Bernhardt was that day!



WHITING-ADAMS BRUSHES

52 Varieties of Nail Brushes

A different Nail Brush for every week in the year. All good, some of them lower prices than others. Different shapes, different stiffness of bristles, suiting all requirements.

Send for Illustrated Literature
JOHN L. WHITING-J. J. ADAMS CO.
Boston, U. S. A.

Brush Manufacturers for Over 114 Years
and the Largest in the World

\$450 A MONTH

We want a representative in every county at once to advertise, accept orders, deliver our marvelous new Quick-Edge Knife and Shear Sharpener to every home. No talking necessary. Sold upon absolute money-back guaranty.

\$15.00 Per Day

Sharpens any kitchen, paring, carving knife, or shears in 10 seconds. A child can use it. No competition. Low priced. Leave fifty on trial—fifty orders at 200% cash profits.



Only
\$2.00
Selling
Price

NEW INVENTION—JUST OUT

Abolishes dull knives and shears forever from every home. No charge for territory. Business furnishes capital. Profits start first day. No experience required. No delay. Send no money. Just write for complete particulars—FREE. Ray Carter, of Mass., sold 36 in 2 hours—profit \$36. Forest Webb, of Pa., sold 12 in 3 hours—profit \$12. Act at once. Write Now. Send name and address, and give name of your county.

QUICKEDGE SHARPENER CO.
621 Sharpener Bldg., 159 W. Pearl St. Jackson, Mich.

Anyone CAN LEARN!

No talent or experience necessary. Fascinating work. Pays big money. Complete instruction book TELLS ABOUT: Alphabets, Colors, HOW TO MIX PAINTS, Show Cards, Window Boards and Wall Signs, Ready made letters, Gilding, TRICKS OF THE TRADE, also gives 100 Alphabets and Designs. Book bound in flexible fnt. leather, gold edges, and four half bearing Show Card Pens. Book and Pens sent postpaid for \$3.00. (C. O. D. 10c extra.) Ogilvie Pub. Co., 57 Rose St., Dept. 72, New York

EARN MONEY IMMEDIATELY—WE FURNISH EQUIPMENT TO START

How to Paint Signs and Show Cards

CLASS PINS

FREE CATALOG GIVE NAME OF SCHOOL OR CLUB AND NUMBER IN CLASS

Either pin illustrated made with any 3 letters and 2 figures, 1 or 2 colors enamel Silver plate, 25¢ ea., \$2.50 doz. Sterling silver, 40¢ ea., \$4.00 doz. Write for catalog of sterling and solid gold pins and rings.

Bastian Bros. Co. 542 Bastian Bldg., Rochester, N.Y. 3629

DRIVE This Beautiful RACEABOUT INSTEAD OF YOUR OLD FORD

Flat or Bullet Nose Radiator. Choice of four colors. Send for complete Catalog of Auto Bodies, Accessories and Speed Power Equipment. Direct from factory.

AMERICAN TOP AND BODY CO., Lee St., Delphi, Ind.



AGENTS 500% PROFIT

Genuine Gold Leaf Letters

GUARANTEED TO NEVER TARNISH



For store fronts, office windows, Bank windows, Office Doors, Panels, Board Signs, Trucks, Automobiles and Glass Signs of all kinds. Anyone can put them on and make money right from the start without previous experience.

All you have to do is to show your samples; the letters are very attractive and easy to sell. Letters costing 3½¢ sell for 25¢. One agent says: "Your Letters are the best thing I have seen in years; I have made \$125.00 the first week and still going strong." Paul Clark says: "Smallest day \$28.70." H. Gilder made \$835.00 in six weeks.

\$60 to \$200 a Week

GENERAL AGENTS— It is easy to appoint sub-agents for this line. We pay you 20% cash commission on all orders we receive from local agents appointed by you anywhere. We allow you 50% discount on your own orders. You can sell to nearby trade or travel all over the country, as you please. Large demand for window lettering everywhere. Write today for free sample, full particulars and liberal offer to general agents.

Metallic Letter Co., 433-A N. Clark St., Chicago

5 SQUARES IN 1 TOOL

TRY, MITER, OCTAGON, BEVEL and PROTRACTOR Square all in one handsome tool.



SIMORE "Lightning Change" TRY-SQUARE

With 4 1/4 or 6 inch blade..... \$3.75
With 7 1/4 inch blade, postpaid..... \$3.90

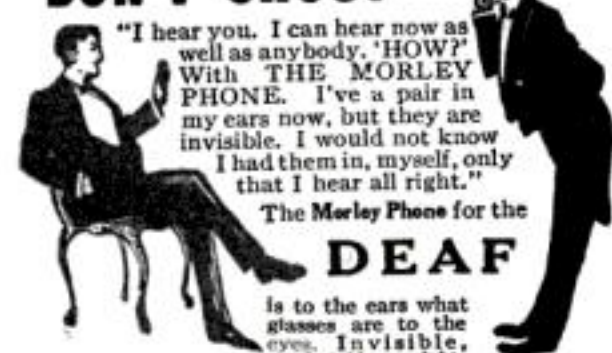
Money order or your check acceptable.

Your money back if not satisfied.

Dealers are invited to write for our proposition on this and other Simore "Lightning-change" tools. The Combination knife and screwdriver is a sure seller.

THE SIMON & SKIDMORE MFG. CO.
Dept. 5-2 Santa Ana, Calif.

"DON'T SHOUT"



THE MORLEY CO., Dept. 797, 10 S. 18th Street, Philadelphia

Senses and Common Sense

(Continued from page 38)

Ninety-nine men in a hundred, feeling a piece of cloth, and receiving just as many touch impressions from its temperature, texture, roughness or smoothness, would pay no attention to them, just as they probably would fail to observe whether the dials of their watches contained Arabic or Roman numerals. And those 99 men would remain in the crowded ranks of poorly paid routine workers, while the hundredth man became a textile expert at a high salary.

I have seen expert machinists gaging the thickness of metal pieces almost as accurately as with a micrometer by feeling them. Others achieve the same degree of accuracy with their eyes. Especially gifted men? Not at all. Merely men who have learned the habits of attention and of interpreting their sensations correctly. At the beginning their jobs depended on this faculty, and in time the habit of attention, instead of being irksome, became comparatively easy.

If you drive an automobile or ride in one frequently, you probably have learned to judge speed and distance. Certainly you can distinguish between a speed of 25 miles an hour and 30 miles an hour without consulting the speedometer. A few years ago you could not do this. The faculty has come to you because you have trained your sense of sight unconsciously while motoring.

Senses Improve with Use

This illustrates vividly an important consideration—that the senses improve with use. Moreover, the consciousness of possessing senses that are trained and so can be depended on to transmit accurately to the brain the impressions they receive, brings the self-confidence that is certain to lead on to greater achievements. Through the senses we obtain knowledge, and knowledge is power.

The carpenter reaches into his chest and without looking draws out the tool he wishes to use. Training of his sense of touch has taught him to differentiate unerringly between the feel of the handle of a chisel or some other tool.

To a layman the ledger of a commercial enterprise seems merely an unfathomable jumble of figures. To an accountant's trained eye, though, it tells a vivid story of the state of the concern's business health.

I might multiply examples of the sort without number—ordinary persons who excel their fellows by no natural equipment of talent, but who have acquired a high degree of useful skill simply through practice and the use of their senses. Typists, linotype operators, printers, musicians, draftsmen, artists, lawyers, surgeons, dentists, writers, workers in many fields of science—all these win success in the degree to which they develop one or more of the senses.

Touch, eyesight, and hearing probably are the senses most generally employed in the more familiar forms of human endeavor. But even the sense of smell, so little developed in the ordinary man and regarded by him as extremely unimportant.

(Continued on page 146)



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY if you lack **HANDICAPPED** High School training.

You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE

This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and meets all requirements of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people idle away fifty hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within two years. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

American School

Dept. H275

Drexel Ave. and 58th St., Chicago

American School

Dept. H275

Drexel Ave. & 58th St., Chicago

Send me full information on the subject checked and how you will help me win success.

- | | |
|------------------------------|----------------------------|
|Architect |Lawyer |
|Building Contractor |Machine Shop Practice |
|Automobile Engineer |Photoplay Writer |
|Automobile Repairman |Mechanical Engineer |
|Civil Engineer |Shop Superintendent |
|Structural Engineer |Employment Manager |
|Business Manager |Steam Engineer |
|Cert. Public Accountant |Foremanship |
|Accountant and Auditor |Sanitary Engineer |
|Bookkeeper |Surveyor (& Mapping) |
|Draftsman and Designer |Telephone Engineer |
|Electrical Engineer |Telegraph Engineer |
|Electric Light & Power |High School Graduate |
|General Education |Fire Insurance Expert |
|Vocational Guidance |Wireless Radio |
|Business Law |Undecided |

Name

Address

BOYS



Drawn from actual photograph of student doing spare time electrical work

Learn Electricity Make Big Money

How would you like to earn two or three dollars every evening after school and prepare yourself for a fine big job at the same time? Here's the opportunity of a lifetime for you fellows who like Electricity. Begin right now to prepare yourself for a regular man's size job in this fascinating field. Your chances for a big success are simply wonderful—the pay is big (\$70 to \$200 a week) and advancement comes swift and sure.

I will Train You at Home

With my easily learned, spare time Electrical Course I will train you at home like I have trained hundreds of other boys who are now big successful men. It will not interfere with your school work and you can earn more than the small cost of the course doing odd electrical jobs in your spare time. The Course pays for itself. I will show you how to get this work and how to do it. Some of my boy students make \$10 to \$15 a week this way.

Tools, Apparatus and Radio Course FREE

Send me the coupon below and I will tell you all about the big outfit of tools, apparatus and instruments and a new Radio Course that I am giving to my students for a limited time. I will send you my big interesting Electrical Book and a sample lesson, too—all Free. You will be tickled with the things I will send you Free. Mail the coupon right now.

L. L. COOKE, Chief Engineer
Chicago Engineering Works
Dept. 532 CHICAGO

Look What This Boy Is Doing

"Although the School term is coming to a close, and I am pretty busy with my examinations, I manage to keep up with my electrical studies and work. I guess I forgot to tell you I am now in business for myself. Am doing fine, but owe it all to you. If it had not been for your Course, I, being under age, could not have secured my license in this town. But I got it, and now have all the work I can do, averaging \$20 to \$30 a week, thru spare time work. I went out on a job tonight after school, on which I made \$3 and brought home another on which I made \$2.50—\$5.50, for 4 hours' work and no material furnished by me."

ROGER SMITH
1215 Chestnut St.
Greenville, N.C.

Use This "FREE OUTFIT" Coupon

L. L. COOKE, Chief Engineer,
Chicago Engineering Works,
Dept. 532, 2150 Lawrence Ave., Chicago

Send me your Free Outfit Offer, your big Electrical Book, Sample Lesson and particulars of your Electrical Course and Free Radio Course. This will not obligate me in any way.

Name.....

Address.....

This Coupon only for use of boys 15 years old or more.

Senses and Common Sense

(Continued from page 145)

tant so far as practical life is concerned, is used by many persons with such nice powers of discrimination that they not only make a good living, but often represent a vital link in the affairs of important industries. Tea tasters and testers of tobacco, foods, perfume, and beverages are only a few of those who utilize their trained sense of smell for their own benefit and the benefit of mankind.

But, you may say, how does all this apply to me? I have no wish to be a tea taster; it is not necessary for me to be able to estimate the thickness of materials by my sense of touch. I have a job. My work is all cut out for me.

Are you satisfied with that job? Don't you want to advance beyond it? There is no surer way for you to win promotion than by sharpening your senses through exercise.

If you are an office worker, for example, your sense of sight, your sense of hearing, several of your senses of touch are called into play. If you are a salesman, the same senses are used by you, but they must record their impressions with greater rapidity, because your work is less of a routine nature and you are constantly confronted with the necessity of solving new problems. If you are a manual worker, your senses of touch and sight are your bulwarks.

Conscious Use Trains the Senses

Learn to use these senses consciously. If you are looking at a thing, don't be satisfied to let that thing merely happen across your vision like a flash of light. See not only the thing itself—its size, shape, and color—but perceive and record the things surrounding it and their relation to the principal object.

Hear things, smell things, touch things, taste things in the same manner. Muster every sense you can in obtaining your impressions of an object, whether it is a column of figures in a ledger, a bolt of cloth of a new pattern, a blueprint drawing, a letter. Sense it in terms of other things with which you already are familiar. That is how the textile expert gages the value of materials, how the physician diagnoses the illness of his patient, how the machinist estimates the size of materials.

Learn to concentrate. These few words are the key that will unlock the wonderful storehouse of hidden powers in your mind.

If you will concentrate—on your pleasures and hobbies as well as on your tasks—your senses will train themselves. Your eyes are eager to see, your ears to hear, your other senses—25 or more—to perform their functions. They will develop if you will give them free rein by cultivating the habit of attention, a thing which because it offers so many advantages and so much profit to you, you should be prompted to do through the exercise of that greatest sense of all—common sense.

In next month's article Doctor Walsh will tell why we are what our habits make us, and how we can make and break our habits.

AT ALL RADIO DEALERS

If your dealer cannot supply you send money direct and your order will be promptly filled.

WM. J. MURDOCK COMPANY
345 Washington Ave., Chelsea, Mass.

MEN WANTED

We have positions open now that will pay from \$45 to \$100 a week. We are organizing a sales force to introduce the Cole Visible Gasoline Gauge, a low-priced, scientifically accurate instrument for Ford and Chevrolet cars. Prevents running out of gas. Guards against short measure. Fits on instrument board—always in sight. Big selling records.

MAKE \$50 THE FIRST WEEK
We want one man in each county. Our campaign is just beginning. Capital is not necessary. We help you start. Territory going fast. Write to THE STEMCO ENGINEERING CO., 118 Webb St., Dayton, O.

EARN MONEY AT HOME

YOU can make \$15 to \$50 weekly in your spare time writing show cards. No canvassing or soliciting. We instruct you by our new simple Directograph System, supply you with work and pay you cash each week. Write today for full particulars and free booklet.

WEST-ANGUS SHOW CARD SERVICE LIMITED
Authorized Capital \$1,250,000.00
63 Colborne Building, Toronto, Can.

DON'T WEAR A TRUSS

BE COMFORTABLE—

Wear the Brooks Appliance, the modern scientific invention which gives rupture sufferers immediate relief. It has no obnoxious springs or pads. Automatic Air Cushions bind and draw together the broken parts. No salves or plasters. Durable. Cheap. Sent on trial to prove its worth. Beware of imitations. Look for trade-mark bearing portrait and signature of C. E. Brooks which appears on every Appliance. None other genuine. Full information and booklet sent free in plain, sealed envelope.

BROOKS APPLIANCE CO., 230 State St., Marshall, Mich.



MR. C. E. BROOKS



Planning a NEW HOME?

Let these Books be your Guide. Beautiful California Styles, with Pictures and Plans for all climate homes.

SPECIAL OFFER:
Send \$2.50 for any three Books and Garage Folder.

Money back if not satisfied.

E. W. STILLWELL & CO., Architects, 110 Calif. Bldg., Los Angeles

"All-American Homes"
50 Houses—7 to 16 Rooms—\$1
"South-West Stucco Homes"
Spanish, English, some 2-family, \$1
"The New Colonials"
60 Houses—6 to 10 Rooms—\$1
"West Coast Bungalows"
50 Houses—6 and 7 Rooms—\$1
"Little Bungalows"
75 Houses—3, 4 and 5 Rooms—\$1

Astronomy from the Cellar

(Continued from page 41)

give us no clear perception of the immense distances of the universe. Even to say that the sun is 93,000,000 miles away from us cannot convey a definite impression to the inhabitants of a planet only about 8000 miles in diameter, to whom an airplane journey of 3000 miles in a little more than a day seems almost incredible.

"How can we comprehend, then, that some of the stars of the Milky Way are more than one hundred thousand trillion miles away from us? Write this number on a piece of paper—100,000 followed by 12 ciphers—then try to picture the distance in terms of any earthly measurement, such as the breadth of the Atlantic Ocean. Of course, this gives you no comprehensible picture, but don't let that discourage you. Astronomers have been trying unsuccessfully for centuries to comprehend the awful distances of space. Even using the light year—an astronomical unit equivalent to about six million million miles—they are unable to picture understandably the sublime abysses of the worlds beyond.

"Astronomy has been my hobby for many years. I have pursued it unceasingly and with ever-increasing enthusiasm. There was a time when I believed there was no room in my life for anything but my work. I had taught myself to work constantly, every hour of the day.

"And then I made the important discovery that, commendable and important though industry may be, a man must have some other interest beyond his work.

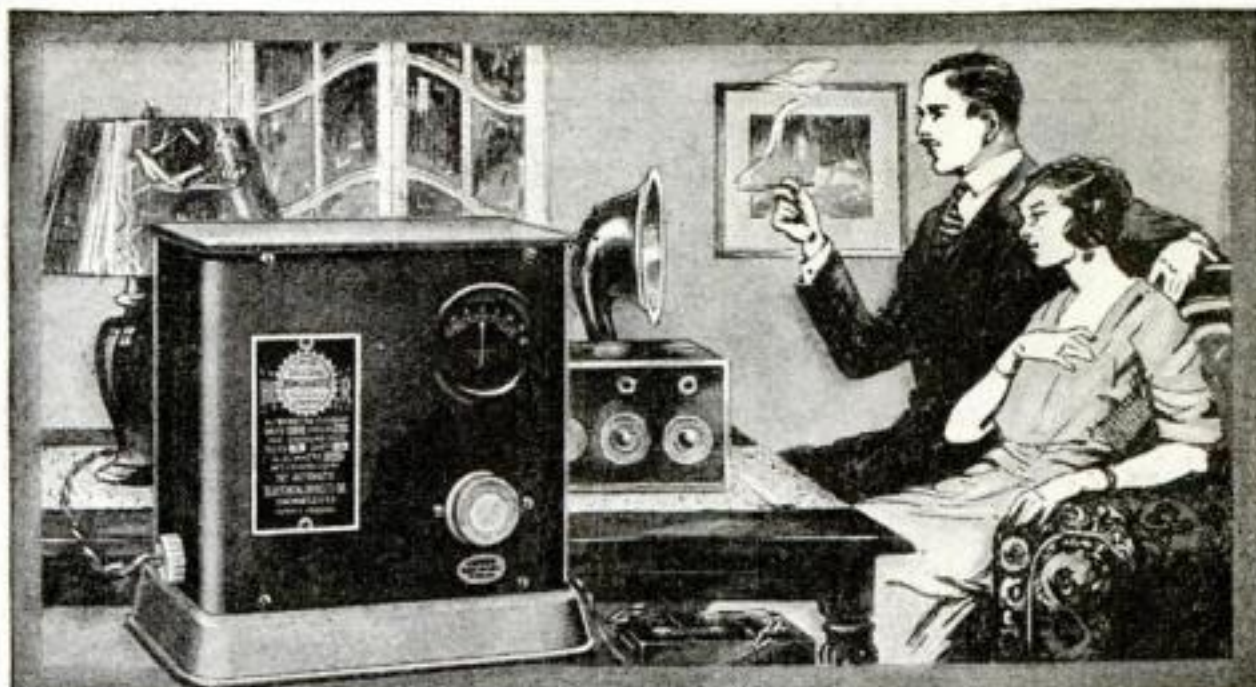
The Telescope Opened His Eyes

"I took up yachting, and for several seasons it served its purpose of taking my mind from my business cares. Then, returning from a business trip to Europe one summer, I was unpleasantly shocked to find that my eyes no longer were able to pick up distant objects at sea as they formerly had been. Astronomers and others frequently had described to me the wonders of the heavens, and I decided then that if ever I was to see those wonders it was time to start. So when I landed in New York I bought a telescope.

"That instrument opened my eyes to the marvelous sights the heavens offered, and before I knew it I was unescapably bound to the fascinating study of astronomy. However, there were certain inconveniences connected with astronomical observation as I was conducting it. In the warm weather mosquitoes made it a somewhat heroic undertaking. In the fall and winter the cold winds chilled me to the bones. For self protection I built my underground observatory.

"In designing my observatory I was helped rather than hampered by my lack of technical knowledge of approved methods. I produced an observatory that suited my purpose, even though experts told me my methods were wrong. The observation chamber and the tunnel connecting it with my home were the first units completed. The tunnel carries water and heating pipes and electric wires

(Continued on page 148)



The hook-up that eliminates battery trouble

Some radio fans are still slaves to their batteries—lug them to service stations every time they need recharging—allow them to spoil many evenings' entertainment by running low.

Other fans—and they're quickly coming to be the vast majority—have found new economy and convenience in the GOLD SEAL HOMCHARGER, the world's best as well as its most popular rectifier. With it any radio or auto battery can be charged at home overnight—for a nickel. Simple, dependable, practically silent and absolutely safe. Beautifully finished in mahogany and gold. Approved by Underwriters. UNQUALIFIEDLY GUARANTEED. Over 150,000 now in use.

WHY PAY MORE—OR GET LESS?

Why buy a 2 or 3 ampere rectifier without ammeter requiring from 40 to 50 hours to charge your battery and costing twice as much to operate when, for the same price you can secure the genuine 5-ampere GOLD SEAL HOMCHARGER which does

a better job in one-third the time and at half the cost. Fitted with high grade ammeter (eliminating guesswork) charging cable and battery clips—no extras to buy. For sale by all good dealers—\$18.50.

Insist on the GOLD SEAL

Accept no substitute. No other charger is just as good. Insist on seeing our registered trade mark, the GOLD SEAL, on name plate and carton before purchasing.



RADIO FANS—ATTENTION!

FREE Ask your dealer for a free copy of the HOMCHARGER international list of broadcasting stations. Contains call letters, location, name and wave length of nearly every broadcasting station in the world.

DEALERS—JOBBER!

Prepare for the big HOMCHARGER year ahead by writing today for a copy of our elaborate merchandising plans. In it is illustrated many attractive sales helps that will enable you to get your share of this business.

The Automatic Electrical Devices Co., 131 West Third St., Cincinnati, O.

Largest Manufacturers of Vibrating Rectifiers in the World

GOLD SEAL HOMCHARGER

Stop Using a Truss



Reduced
Fac-Simile
Gold Medal

STUART'S PLAPAO-

PADS are different from the truss, being mechanico-chemical applicators made self-adhesive purposely to hold the distended muscles securely in place. No straps, buckles or spring attached—cannot slip, so cannot chafe or press against the pubic bone. Thousands have successfully treated themselves at home without hindrance from work—most obstinate cases conquered. **Reduced Fac-Simile Gold Medal** Soft as velvet—easy to apply—inexpensive. Awarded Gold Medal and Grand Prix. Process of recovery is natural, so afterwards no further use for trusses. We prove it by sending Trial of Plapao absolutely **FREE**. Write name on Coupon and send **TODAY**.

Plapao Co., 790 Stuart Bldg., St. Louis, Mo.

Name
Address
Return mail will bring Free Trial Plapao.



Reduced
Fac-Simile
Gold Medal

ACE TYPE 3C CONSOLETTTE

This set has beautiful solid mahogany, wax finished cabinet and greatly adds to the appearance of any home.

Consists of a regenerative tuner, detector and two stages of amplification, with built in loud speaker. The tuning circuit is licensed under the Armstrong U. S. Patent No. 1,113,149 and due to the particular method of winding Crosley coils it is exceptionally selective. Has sufficient room inside cabinet for dry batteries, making a complete self-contained long range receiving outfit. Has phone jack for tuning with head phones. Crosley multistat; filament switch; Crosley moulded condenser, beautifully engraved formica panel. Uses all kinds of tubes. Price \$125. Prices do not include batteries or tubes.

If your dealer cannot supply you order direct mentioning his name.

THE PRECISION EQUIPMENT CO.

Powel Crosley, Jr., Pres.
217 Vandalia Ave. Cincinnati, Ohio

"What a whale
of a difference
just a few cents
make"

All the difference
between just an ordinary
cigarette and the most skillful
blend in cigarette history.

FATIMA
—a mild cigarette

Astronomy from the Cellar

(Continued from page 147)

to the observatory, and also provides a protected passageway.

"I have added to the observatory from time to time, until now I have a complete underground bungalow. The general layout and the size of the chambers, by the way, bear quite a striking similarity to the tomb of Tut-Ankh-Amen.

"Of course, having become tremendously interested in astronomy myself, I would like every one else to share my interest. It is most gratifying to me to know that 18 young men in Springfield have built their own telescopes, which they carry up the mountains to pursue astronomical observation.

"If people only knew the thrill and stimulation of a telescopic journey into other worlds, I am sure that when building their homes they would open a window to the sky before opening one to the street. Why have a window through which you can see only a dog fight or a few persons passing along the street when you might have one that will show you the vast depths of space and the stars and planets that lie there? There is no special background of education needed to undertake an intelligent study of astronomy in a human way; merely a capacity to appreciate and to make comparisons between things of tremendous magnitude and things that matter little.

"I was talking of astronomy to a young man whom I met on a train recently. I tried to make clear to him its wonderful interest and its thrilling possibilities, even for a layman. He listened to me, then said:

Schoolbook Astronomy Fooled Him

"Well, if that's astronomy, they fooled me badly when I was studying it in school! My book on astronomy had a lot of funny diagrams, and hazy pictures of stars with long names and some problems in spherical trigonometry. I hated it!"

"Many schools approach the teaching of astronomy from the wrong direction. Looking at a picture of a star bears about the same relation to seeing the star itself through a telescope as looking at a friend's picture bears to having the friend beside you, talking to you. See here."

Mr. Hartness turned an electric switch and immediately on the four walls of his study appeared four life-size pictures—a young woman, a little girl, an elderly man, and President Coolidge and his family. Mr. Hartness smiled and pointed to an odd instrument that stood beside his desk.

"A projector," he explained. "I find that by projecting the pictures of my family and friends in life size on the walls they are brought nearer to me than if I merely had their photographs framed and hung there. That illustrates in a way what I mean by the difference between seeing a star and seeing a picture of one."

"One of the valuable lessons we can take from astronomy is the necessity of staying on the job. Our earth and all the greater and lesser bodies beyond have been traveling unceasingly and unfailingly through the same orbits for millions and millions of years. They never falter in their course—an example that all of us well might follow!"

YOU TOO CAN PLAY THE HAWAIIAN GUITAR

JUST AS THE HAWAIIANS DO!

PLAY ALL THE LATEST HITS

After Your FIRST LESSON You Will Play a Complete Selection. We Guarantee That—

Our method is so simple, interesting and appealing that you begin in your first lesson to learn the famous Hawaiian Folk Song "ALOHA". Think how happy you will be when you surprise your friends by playing the fascinating Hawaiian Guitar.

Only Four Motions--and You Master Them Quickly!

In a few minutes you acquire the four motions necessary to play any piece—after that a short period of practice and you will have mastered this wondrously sweet music. Complete course of 52 lessons includes FREE beautiful Hawaiian Guitar, necessary picks, steel bar, etc. No extra.

No Previous Musical Knowledge Necessary

If you never read a musical note in your life—if you haven't even the slightest knowledge of music, we can quickly and positively teach you to play this wonderfully popular instrument. Don't be just a "listener" when you can easily be the center of interest among your friends. Over 40,000 successful students.

Just Mail a Post Card for Details of our remarkable FREE Hawaiian Guitar Offer—simply write: "I am interested"—but do it today.

First Hawaiian Conservatory of Music, Inc.
Desk 45 2338 Broadway
(Woolworth Bldg.)
New York City



FREE
A Beautiful
Hawaiian
Guitar

Home Protection

with an
ASTRA
Automatic

will cost little



Nearly every man wants a gun in the house—he feels better able to protect his family. We are able to offer these Genuine Astra guns at special prices because we bought before recent tariff raises became effective. Really fine guns, beautifully finished, hard hitting. Use standard ammunition. Order direct from U. S. Importers.

\$7.75 25 calibre—7 shot—C. O. Q. Automatic.
8.95 25 calibre—7 shot—Astra Automatic.
9.95 25 calibre Astra with triple safety.
10.35 32 calibre—10 shot Astra, extra magazine.
16.95 32-20 and 38 cal. swing-out cyl. revolvers.

We guarantee every gun against defective workmanship; brand new; of Drop Forged Steel Through-out. Before buying any weapon **INSIST** on this guarantee. **SEND NO MONEY** unless you wish. State model desired—pay postman on delivery plus postage. Satisfaction guaranteed or money refunded. Write for new firearms catalogue.

CALIFORNIA TRADING CO.

Dept. 12, Terminal Bldg., Los Angeles, Cal.

Recent Publications

A résumé of new books on science and invention

Constructive Conscious Control of the Individual, by F. Matthias Alexander. A companion volume to the author's earlier work, "Man's Supreme Inheritance," offering a constructive plan of life and education suited to the psychophysical development of man in his present environment of civilization. E. P. Dutton & Co.

The A B C of Atoms, by Bertrand Russell, F.R.S. A popular explanation of the new theory of the composition of matter, including a discussion of relativity, the wave theory of light, radioactivity and X-rays. E. P. Dutton & Co.

Everyday Mysteries—Secrets of Science in the Home, by Charles Greeley Abbot, D.Sc., Assistant Secretary of the Smithsonian Institution. A popular exposition of the scientific romance in everyday things—household appliances and the familiar phenomena of nature. Illustrated. The Macmillan Company.

Fundamentals of Radio, by James L. Thomas, formerly instructor in radio, U. S. Army. A review of the elementary principles of radio, and a non-technical explanation of the common radio circuits. Illustrated. D. Van Nostrand Company.

Masters of Science and Invention, by Floyd L. Darrow. Brief biographies of leading scientists from Galileo to Einstein. Illustrated. Harcourt, Brace & Co.

Great Inventions and How They Were Invented, by Charles R. Gibson, F.R.S.E. Illustrated. J. B. Lippincott Company.

Civilization and the Microbe, by Arthur I. Kendall, dean of the Northwestern University Medical School. Illustrated. Houghton Mifflin Co.

Essays of a Biologist, by Julian Huxley. Alfred A. Knopf.

Substance and Function, and Einstein's Theory of Relativity, by Ernst Cassirer. Translated by William Curtis Swabey and Marie Collins Swabey. The Open Court Publishing Company.

Elementary Zoology, by Oswald H. Latter, M.A. Illustrated. E. P. Dutton & Co.

Conservatism, Radicalism and Scientific Method, an essay in social attitudes, by A. B. Wolfe, professor of Economics and Sociology, University of Ohio. The Macmillan Company.

A Textbook of Physics (eighth edition) and *General Physics* (second edition), by W. Watson, revised by Herbert Moss, of the Imperial College of Science and Technology, London. Illustrated. Longmans, Green & Co.

Furnace Heating, by William G. Snow, revised and enlarged. U. P. C. Book Co.

America in Spitzbergen, by Nathan Hale Dole. Marshall Jones Company.

Reactionism, The Science of You, by John D. Boyle. G. P. Putnam's Sons.

Columbia Dry Batteries

—they last longer.

—the steel case battery defies water and weather.



Packed with energy

INTENSE, fiery sparks start things moving and keep them going wherever Columbias are hitched. Lasting strength for heavy drains. Quick pick-up of fresh energy between uses in intermittent service. Easy to buy anywhere. Sell so fast that dealers are sure to have fresh stock.

Hot Shots contain 4, 5 or 6 Columbia Dry Cells in series in a neat, water-tight, weather-proof metal case.

Columbia Dry Batteries are sold by electrical, hardware and auto accessory shops, marine supply dealers, implement dealers, garages, general stores. Insist upon Columbia—Fahnestock Spring Clip Binding Posts on Columbia Ignitor at no extra cost.

NATIONAL CARBON COMPANY, INC.

New York

San Francisco

CANADIAN NATIONAL CARBON CO., Limited

Factory and Offices: Toronto, Ontario

for

- | | |
|--------------------------|--------------------------|
| —Motor boat ignition | —Running toys |
| —Gas engine ignition | —Telephone and telegraph |
| —Tractor ignition | —Lighting tents and out- |
| —Starting Fords | buildings |
| —Door bells | —Firing blasts |
| —Buzzers | —Heat regulators |
| —Ringing burglar alarms | —Electric clocks |
| —Calling Pullman porters | —Radio A |

Reduce Tubes by Half

With Erla Synchronizing Transformers

Vacuum Tubes
in ERLA Duo
Reflex Circuits

$$\left. \begin{array}{l} 1 = 3 \\ 2 = 4 \\ 3 = 5 \end{array} \right\}$$

Vacuum Tubes
as Ordinarily
Employed —



Increased amplification and elimination of distortion inevitably follow installation of Erla transformers. Reflex and cascade types. \$5



Erla audio transformers add tremendously to the purity and volume of any receiving unit in which they are used. Ratios 3 1/2 and 6 to 1. \$5



Crystal troubles vanish on installing an Erla rectifier. No adjustment required. Proof against jolt and jar. Lasts indefinitely. List \$1

Jobbers—Sweeping success of Erla circuits fosters continually increasing demand for Erla products. Write for terms and discounts.

Nation Wide Loud Speaker Reception With Only Three Tubes

Greater range and volume with fewer tubes than ever before are attained through Erla Duo-Reflex circuits, using Erla synchronizing radio and audio transformers.

In Erla circuits, tubes do triple duty, as simultaneous amplifiers of received radio frequency, reflexed radio frequency, and reflexed audio frequency currents. Through accurate superimposition of currents identical in phase and frequency, by means of Erla synchronizing transformers, this triple function is flawlessly performed, resulting in tremendously magnified amplification without distortion.

Even one tube provides excellent loud speaker reception over a wide range; two tubes blanket the zone ordinarily covered by four; while three tubes bring in stations on the loud speaker from coast to coast.

Other notable improvements, contributing vitally to the superiority of Duo-Reflex circuits, are the Erla fixed crystal rectifier and Erla tested capacity condensers. Combining advanced characteristics for reflex work with unduplicated uniformity, they are indispensable to complete stability and purity of reproduction.

Detailed diagrams and descriptions of Erla Duo-Reflex circuits are presented in Erla Bulletin No. 16. Ask your dealer, or write, giving your dealer's name.

Electrical Research Laboratories
Dept. F 2515 Michigan Avenue, Chicago

ERLA

Here Are Correct Answers to Questions on Page 53

1. Coal is impure carbon. Diamond is pure carbon, crystallized. That is, diamonds have their carbon atoms arranged in a definite form, rigidly fixed.
2. Because the blood clots. This is due to a material called fibrin, which is in the blood. As soon as blood gets out of its proper channels in the veins and arteries, this fibrin begins to form a solid clot or curd. This clot stops up the holes where the blood vessels were cut.
3. Food keeps on cooking as long as it is hot. The fireless cooker merely keeps it hot by preventing the loss of heat.
4. No. Our system of writing music is rather artificial. Out of the millions of possible notes, musicians have selected about 120. These selected notes make up the "scales." The songs of birds often contain notes that are not in this arbitrary system, not because they are higher or lower, but because they fall in between two of our selected notes.
5. The air on the earth holds the heat in, much as the glass of a hothouse holds the heat inside it. On a mountain the air is thinner and does not hold the heat in so well.
6. No. The number of times he comes up, if at all, will depend on his strength, on the weight of his body, on whether the water is salt or fresh, on the currents, etc.
7. When you are tired, two or three lumps of sugar dissolved in a glass of hot water and drunk on an empty stomach make an excellent stimulant. It is harmless except to those who cannot eat sugar.
8. It is the speed with which nerve messages can be passed around inside the brain. This is very great. The speed of nerve impulses, you remember, is 404 feet a second. Suppose you think of an idea so complicated that it requires 100 successive nerve messages from one side of the brain to another. All these 100 messages can be carried and the thought can be completed in less than a tenth of a second.
9. Because during millions of years the rains have been wearing down the land and carrying the dust and sand from it into the sea, and enough of it has accumulated to make the sea salty.
10. Compress it by a pump, like a tire pump. Remember that heat is really the motion of the atoms vibrating back and forth. When you compress air, you push its atoms closer together. This makes them hit against each other more often and makes them vibrate faster.
11. The record is made on a disk of soft wax. The sound from the musician enters the horn and makes the needle vibrate. This vibration causes the sharp point of the needle to make a series of tiny microscopic marks on the bottom of the wax groove in which it is running. These marks are an exact picture of the sound. When an ordinary hard record is made from this soft wax one, it contains these same marks. When you play it, your needle runs over these marks and they make it exactly reproduce the sound that made the marks on the wax.
12. It is a mixture of two chemicals with oxygen that produces the light. One of the chemicals is used up in the process and perhaps both are. It has been impossible to duplicate these chemicals.

Motorcycle Bargains

SAVE 25% to 65%
on Slightly Used and Rebuilt Motorcycles, Ace, Indian, Excelsior, Harley-Davidson, Cleveland, Side Cars, Johnson Motor Wheels, Evans Power Cycles, Bicycles. Send for Free Bargain Bulletin and Money Saving Message, listing hundreds of bargains in used, rebuilt and new machines, supplies, accessories, etc.
AMERICAN MOTOR CYCLE CO.
Dept. 226 2047 W. Chicago Ave. CHICAGO



Print Your Own Stationery

letterhead, envelope, receipt, tags, menus, circulars, cards, etc. Press \$12. Larger \$35. Job Press \$100 up. Easy to operate by our printed rules with every press. **MAKE MONEY!** Print for others in spare time. Write today for catalogue, presses, type, cards, envelopes, paper, supplies. **THE PRESS CO., D-33 Meriden, Ct.**

MAKE BIG MONEY CHARGING BATTERIES

Small cash payment brings you **HB 8 hour charging outfit**. Easy terms of only \$50 monthly let your profits pay balance with nice surplus besides. Thirty day free trial on money back guarantee lets you try HB outfit at our risk. You can easily make \$150 to \$200 monthly. Start now to make big profits with HB 8 hour battery charger. Write today for Bulletin 321.

HOBART BROS. CO.

Box P2

Troy, Ohio



Save \$35.00
Recover your old auto top frame yourself. \$3.85
Parcel Post Paid AND UP
Custom tailor made to fit all makes and models of cars. Any person who can drive a car can put it on. Roof and quarters sewed together, with rear curtain, fasteners, welts and tacks complete. Give name, year and model number of your car, and we will send you catalog with samples.
Liberty Top & Tire Co., Dept. E-8, Cincinnati, O.

This One



4FOH-9RO-U4DW



Save $\frac{1}{3}$ on Guaranteed Radio Equipment

Write us a post card

Address Dept. 5-R

and we will send you free this 52 page catalogue of radio sets and parts. It also contains explanation of radio terms, map and list of broadcasting stations and much radio information, including an explanation of successful hook-ups and circuits.

You will be amazed at the low prices Ward's quote. A complete tube set having a range of 500 miles and more, including tube, head set, batteries, and antenna equipment, as low as \$23.50.

This catalogue contains everything for the expert and amateur. Complete sets and every improved part for building sets, all the most up-to-date devices—at the lowest possible prices.

Headquarters for Radio

Montgomery Ward & Co. is headquarters for Radio, selling everything direct by mail without the usual "Radio-profits." Why pay higher prices? Ward quality is the best and the prices will often save you one-third. Everything sold under our Fifty Year Old Guarantee—Your Money Back if You Are Not Satisfied. Write today for your copy of this complete 52-page Radio Book.

Write to our house nearest you. Address Dept. 5-R

Chicago

Kansas City
Ft. Worth

St. Paul
Oakland, Cal.

Portland, Ore.

**Radio
EQUIPMENT**



MONTGOMERY WARD & CO.

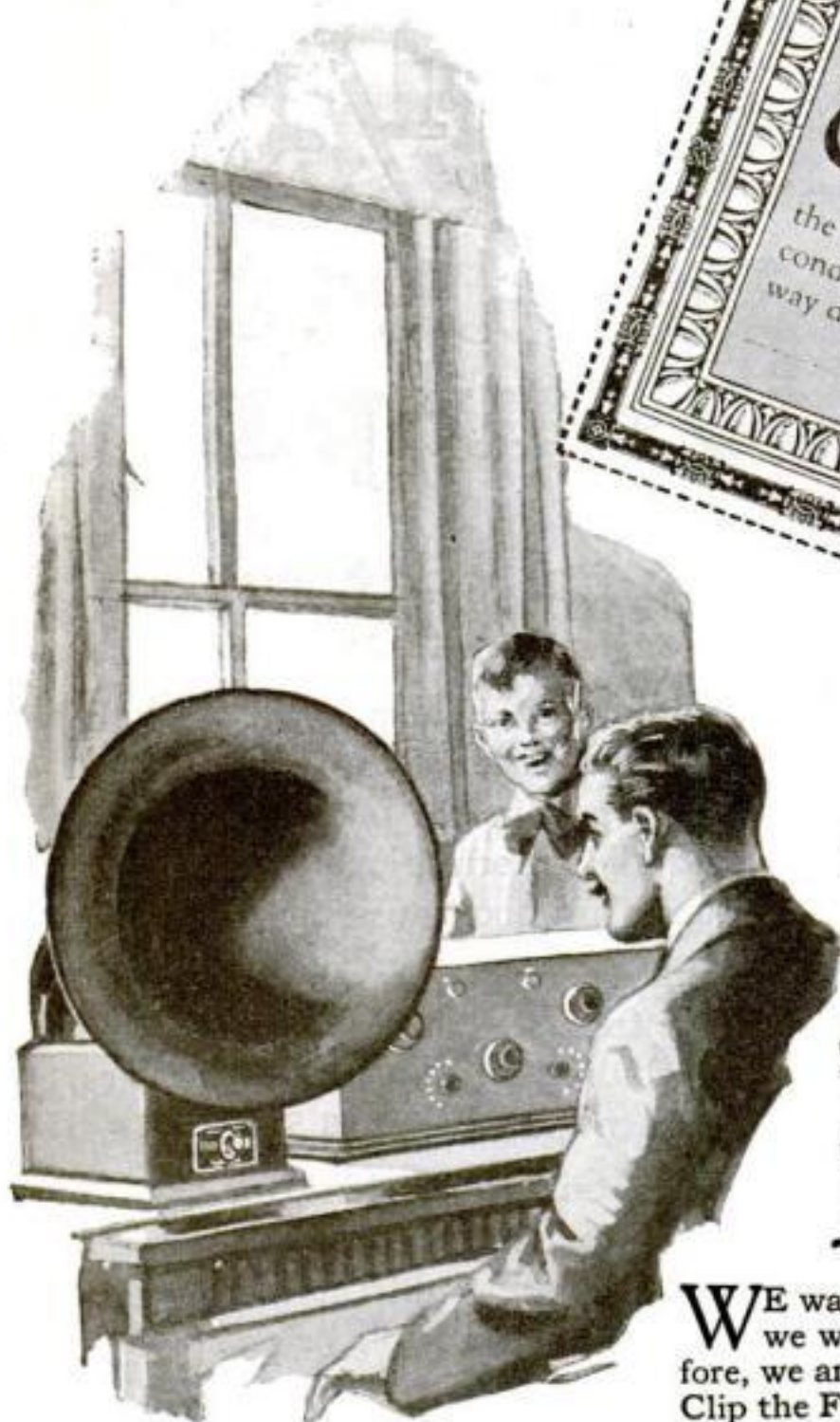
Chicago Kansas City St. Paul Portland Ore. Ft. Worth

**This Radio
Catalogue
FREE**

Established 1872

Montgomery Ward & Co.

The Oldest Mail Order House is Today the Most Progressive



The DICTOGRAPH operates at a maximum efficiency under all conditions on any set having two or more stages of amplification. Just a slight turn of the knob regulating the air gap (a patented feature), and the entertainment comes in, in exactly the same tones and with the same clarity as the original production miles away.

The DICTOGRAPH Radio Loud Speaker is guaranteed for a period of one year against all electrical or mechanical defects.

\$24.50

APPLAUSE CARD

BROADCASTING STATION _____

CITY _____

STATE _____

The artists who give their services to the invisible Radio audiences are human and welcome the appreciation of those they entertain. That you may express your appreciation of the artists who entertain you we supply "applause cards." You can secure a package from your dealer—free. If your dealer cannot supply them write to us.



Try the **DICTOGRAPH** Loud Speaker on this **FREE Trial Certificate**

WE want you to hear the marvelous DICTOGRAPH Loud Speaker—we want you to hear it in your own home on your own set. Therefore, we are making this offer:

Clip the Free Trial Certificate at the top of the page and present it to the radio dealer in your town. He will deliver to you a DICTOGRAPH Loud Speaker that you can *use in your home for five days*. If at the end of five days you are not thoroughly satisfied with the DICTOGRAPH you have the privilege of returning it and receiving back the full amount paid. *This offer makes it possible for you to try the Dictograph on your own set without risking one cent.*

The Dictograph is its own best salesman. We could tell you how the Dictograph has eliminated distortion—we could quote you testimonials from acoustical experts, musicians and singers comparing the quality of tone of the DICTOGRAPH with that of other loud speakers. But we prefer that you judge for yourself.

FREE Trial Offer of Home Demonstration

We make this amazing offer so you can convince yourself on your own set of the marvelously clear reproduction you get with the DICTOGRAPH.

Get a DICTOGRAPH today from your dealer. Present the Free Trial Certificate and have the wonderful Loud Speaker in your home tonight ready to share this evening's program with your family. Tomorrow night you will want to have some of your friends in to hear the wonderful results you can get with DICTOGRAPH.

Clip the Free Trial Certificate and get your demonstration DICTOGRAPH today.

If your dealer can't supply you send the certificate direct to us with your dealer's name.

Clip Today the FREE Trial Certificate

Maybe you are like thousands of others who have thought that some day you would add a loud speaker to your receiving outfit—but you haven't yet found a satisfactory loud speaker. This Free Trial Offer is to convince you of the superior quality of the DICTOGRAPH Loud Speaker so that you may judge for yourself *on your own receiving set* the results you can get with a DICTOGRAPH; we will put one of these marvelous Loud Speakers in your home for you to try for five days. You don't risk a cent in making this test.

DICTOGRAPH PRODUCTS CORPORATION
220 West 42nd Street New York City



E·D·Elliott of Milford, N.Y. establishes a record

Think of getting Fairbanks, Alaska, and La Palma, Panama, when you live in New York! Yet this is the experience of Mr. Elliott, one of the hundreds of enthusiastic users of MIRACO sets. With the inexpensive outfit shown here, priced at only \$29.50, he received the following list of stations—results that would do credit to a set costing three or four times as much.

WLAY	Fairbanks, Alaska	WBAK	Harrisburg, Pa.	WGY	Schenectady, N.Y.
NNW	La Palma, Panama	WLAK	Bellows Falls, Vt.	WJZ	New York City
PWY	Havana, Cuba	WBAN	Paterson, N.J.	WEAF	New York City
CFAC	Calgary, Can.	WOC	Davenport, Iowa	WOR	Newark, N.J.
CJCY	Calgary, Can.	WPAP	Winchester, Ky.	WHAS	Louisville, Ky.
KSL	San Francisco, Cal.	WMAM	Beaumont, Tex.	WEAB	Dodge, La.
KHO	Seattle, Wash.	WWZ	New York City	WKD	Gainesville, Ga.
WJAR	Providence, R.I.	WBAY	New York City	WUQ	Washington, D.C.
KFB	Lorain, Wyo.	WGL	Philadelphia, Pa.	KMO	Tacoma, Wash.
WEV	Houston, Tex.	WMAF	Dartmouth, Mass.	KOB	New Mexico
WMAT	Duluth, Minn.	WBAG	Bridgeport, Conn.	WDAR	Philadelphia, Pa.
WPM	Washington, D.C.	WHAP	Decatur, Ga.	WFI	Philadelphia, Pa.
WRAA	Houston, Tex.	WHN	Ridgewood, N.Y.	WIP	Philadelphia, Pa.
WHB	Kansas, Neb.	WIAR	Paducah, Ky.	KDKA	Pittsburgh, Pa.
KFHB	Hood River, Ore.	WRP	Camden, N.Y.	WCAE	Pittsburgh, Pa.
CFCA	Toronto, Canada	WGAR	Fort Smith, Ark.	KMN	Butte, Mont.
CKCE	Toronto, Canada	WDAK	Hartford, Conn.	KOP	Hood River, Ore.
CJCI	St. John, Can.	WCAG	New Orleans, La.	WHAZ	Troy, N.Y.
WRP	Dallas, Tex.	WHAY	Wilmington, Del.	WGR	Buffalo, N.Y.
NGE	Miami, Fla.	WRAY	Scranton, Pa.	WMAV	Auburn, Ala.
KGA	Oakland, Cal.	WOAY	Birmingham, Ala.	KFDD	Bois, Idaho
KFEL	Denver, Col.	WSB	Atlanta, Ga.	WNAL	Omaha, Neb.
WIAZ	Miami, Fla.	WMU	Washington, D.C.	WCAP	Washington, D.C.
WKY	Oklahoma City, Okla.	WCAT	Rapid City, S.D.	WQAB	Springfield, Mo.
WDAE	Tampa, Fla.	WRC	Washington, D.C.	WFB	St. Louis, Mo.
WEB	St. Louis, Mo.	KYW	Chicago, Ill.	WDR	Detroit, Mich.
WRK	Hamilton, Ont.	KFCB	Phoenix, Ariz.	WNAC	Boston, Mass.
WHAB	Galveston, Tex.	WWT	Buffalo, N.Y.	WBAZ	Columbus, Ohio
6ZV	Salt Lake City, Utah	WHAS	Louisville, Ky.	CFZC	Montreal, Que.
NAA	Arlington, Va.	WCAY	Milwaukee, Wis.	WMAK	Lockport, N.Y.
WJAX	Cleveland, Ohio	WLW	Cincinnati, Ohio	WGF	Des Moines, Ia.
WBZ	Springfield, Mass.	WDAW	Omaha, Neb.	WHAM	Rochester, N.Y.
WOO	Philadelphia, Pa.	WQO	Kansas City, Mo.	WCAM	Villa Nova, Pa.
WOS	Jefferson City, Mo.	WPAW	Wilmington, Del.	WGAY	Madison, Wis.
WOK	Pine Bluff, Ark.	WCE	Minneapolis, Minn.	WWI	Dearborn, Mich.
WLAG	Minneapolis, Minn.	WCX	Detroit, Mich.	WGAM	Orangeburg, S.C.
WFAZ	Charleston, S.C.	WLAZ	Warren, Ohio	WWAJ	Columbus, Ohio
WJAB	Lincoln, Neb.	WAAS	Decatur, Ga.		
WCT	Chicago, Ill.	WTAM	Cleveland, Ohio		
WMC	Memphis, Tenn.	WWJ	Detroit, Mich.		
		WJAZ	Chicago, Ill.		
		WDAP	Chicago, Ill.		

MAIL COUPON TODAY

MIDWEST RADIO COMPANY
808 Main St., Cincinnati, Ohio
Gentlemen:

Kindly send at once:

- ☐ Free bulletin
- ☐ Agents' proposition
- ☐ Dealers' proposition
- ☐ Jobbers' proposition

Name.....

Street address.....

City.....



Radio's finest low-priced receivers

HERE, in the improved MIRACOS, you'll find the same thrill of getting long distances, generally obtainable with only the most expensive and elaborate sets. To the whole family it will furnish entertainment, **unfailingly**, the whole year round—and at an initial price most every family can afford.

It isn't necessary, either, to be an expert at tuning in with the MIRACO. The operation is extremely simple. Scores of users everywhere tell us of the long-distance records they're making—Cincinnati hears 'Frisco, Denver hears Schenectady, New York hears Havana!

Such range as this is made possible through MIRACO'S many new refinements. Improved rheostats with multiple resistance windings enable you to use any type of tube, and a new aluminum shield prevents annoying body capacity effects. Shock absorbing pads prevent tube noises. Fully **GUARANTEED** against defects in material or workmanship. Price for 4-tube outfit shown above only \$54.50.

Other details of MIRACO receivers are explained more fully in our new bulletin. Write today for a copy.

THE MIDWEST RADIO COMPANY

808 Main Street,

Cincinnati, Ohio

The Improved MIRACO

WURLITZER

TRADE MARK REGISTERED
THE WORLD'S LARGEST MUSIC HOUSE



Try Any Wurlitzer Instrument in Your Own Home

YOU may now have any Wurlitzer instrument for a week's free trial in your own home. Examine the instrument, show it to your friends, play it as much as you wish. No obligation to buy—no expense for the trial. We make this liberal offer because we want you to see for yourself the superior quality of Wurlitzer instruments. Noted musicians praise them for unusual tone quality, artistic workmanship and ease of playing. They are used in the finest bands and orchestras throughout the country. Wurlitzer instruments are the result of 200 years' experience in musical instrument building.

Easy Payments

If you decide to buy, payments are arranged in small monthly sums. A few cents a day will pay for your instrument. By buying direct you obtain genuine Wurlitzer quality at moderate prices. Special offers on complete outfits—velvet lined case, all accessories, self-instructor, etc.—all you need at practically the cost of the instrument alone.

Send for New Catalog

The greatest musical catalog ever published! Over 3,000 articles — every known instrument described and illustrated; many of them shown in full colors. Gives you lowest prices and all details of Free Trial, Easy Payment plan. All sent FREE—no obligation. Send the coupon today!

THE RUDOLPH WURLITZER CO., Dept. 1782

120 W. 42nd St., New York 117 E. 4th St., Cincinnati
329 S. Wabash Ave., Chicago 250 Stockton St., San Francisco

Send me, absolutely free, your new illustrated catalog, with prices and description of every known musical instrument. Also tell me how I may try any musical instrument in my own home and pay for it in small monthly sums. No obligation.

Name _____

Address _____

City _____ State _____

Instrument _____
(State instrument in which you are interested.)